ISSN 0377-9335

entomon

A Quarterly Journal of Entomological Research

Vol. 9 MARCH 1984 No. 1

ASSOCIATION FOR ADVANCEMENT OF ENTOMOLOGY
1975

PUBLISHED BY
THE ASSOCIATION FOR ADVANCEMENT OF ENTOMOLOGY
DEPARTMENT OF ZOOLOGY, UNIVERSITY OF KERALA, KARIAVATTOM
TRIVANDRUM, INDIA 695 581

ENTOMON

Entomon is a quarterly journal of the Association for Advancement of Entomology issued in March, June, September and December, devoted to publication of research work on various aspects of insects and other land arthropods.

Address MS and all editorial correspondence to the Managing Editor, *Entomon*, Department of Zoology, University of Kerala, Kariavattom, Trivandrum, India 695 581.

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Annual subscription for institutions:	Rs 150/- in India;	$ 50/- (abroad)
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entomon

Volume 9 March 1984 Number 1

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BRIEF COMMUNICATIONS

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A STUDY ON THE ORIENTAL GENERA OF THE FAMILY EURYTOMIDAE (HYMENOPTERA : CHALCIDOIDEA)

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(*Received 20 March 1983*)

The eurytomid genera of Oriental region now comprise 17 genera which are treated in a dichotomous key and individually commented on briefly, with information on type-species, available host data and on synonyms involved. Two new species, viz., *Desantisca palanichamyi* and *Sycophila peterseni* are described.

(*Key words:* Oriental genera, Eurytomidae, revision)

The Oriential eurytomids have been little studied beyond the work of Burks (1971) and remained poorly known. Having collected and studied reasonably good material in India during the period from 1980 to 1983, it seemed imperative to update at a preliminary framework of revision, the knowledge of eurytomid genera, just of this part of Asia, to facilitate further studies, genusvise, similar to the two previous papers on *Leucospis* and *Dirhinus* (Boucek & Narendran, 1981). So far 17 genera are recognized as occurring in the Oriental region. One undescribed genus has not been included in this paper because certain points concerning its new status are yet to be clarified. The types of new species described here are with the author for the time being but eventually will be deposited at the British Museum (Natural History), London in thankfulness to the authorities of the museum for providing facilities to the present author to work on chalcids during 1979—1980.

For studying the diagnostic features of the family in general and for the latest acceptable classification at the subfamily and tribal levels, the students of this group should consult the works of Peck *et al.* (1964), Burks (1971) and Subba Rao (1978). The morphological terms used in this paper are well known from the current chalcidological literature and therefore are not explained here. The key to Oriental genera provided below is based on females since the classification of eurytomidae is based so far almost entirely on females.

1. **Acantheurytoma** Cameron

Acantheurytoma Cameron, 1911, Soc. Entomol. 26 : 22—23. Type-species: *Acantheurytoma spinifera* Cameron, by monotypy.

Burks (1971) gave a brief account of the genus partly based on a female specimen which lacked its head and partly on some unpublished notes made by Gahan on the type-species. Later Subba Rao (1978) redescribed this species based on a single female collected from Bangalore, from an unidentified larva of a wasp on caster leaf petiole. The present author collected several males

and females of this species from southern Malabar. The male which is hither to unknown in this genus, differs from the female in the structure of the antennae (Fig. 1) and in the structure of gaster (Fig. 2). Apart from the long spine on the scutellum, the species has its front ocellus outside scrobe, laterally carinate cheeks and strong preorbital carinae. The genus contains only the type-species which was originally described from Borneo.

2. Agriotoma Burks

Agriotoma Burks, 1971, *Trans. Am. Ent. Soc.* 97 : 12—13. Type-species: *Agriotoma bakeri* Burks.

This genus is described originally from material collected from Borneo. Apart from the characters mentioned in the key below, the genus possesses the following important features such as the scape exceeding level of vertex, fore and hind femora swollen, notaulices becoming obsolete posteriorly and fore-wing stigmated.

3. Aximopsis Ashmead

Aximopsis Ashmead, 1904, *Mem. Carnegie Mus.* 1 : 259. Type-species: *Aximopsis morio* Ashmead; by monotypy and original designation.

This genus occurs not only in the Oriental region but also in the Neotropical region. Some species of this genus are parasitic on the larvae of weevils. According to Mani (1938) an undescribed species of this genus is probably parasitic on *Tumidiscapus oophagus* in Coimbatore. In this genus the gaster is compressed with a short median dorsal channel at base.

4. Banyoma Burks

Banyoma Burks, 1971, *Trans. Am. Ent. Soc.* 97 : 24—26. Type-species: *Banyoma philippinensis* Burks.

Originally described from Philippines, based on six females and two males. The genus is characterized with laterally carinate cheeks, scape reaching level of vertex, and a median furrow on the propodeum. Host of this genus is not known so far. The type-species is the only species reported in this genus.

5. Bephratoides Brues

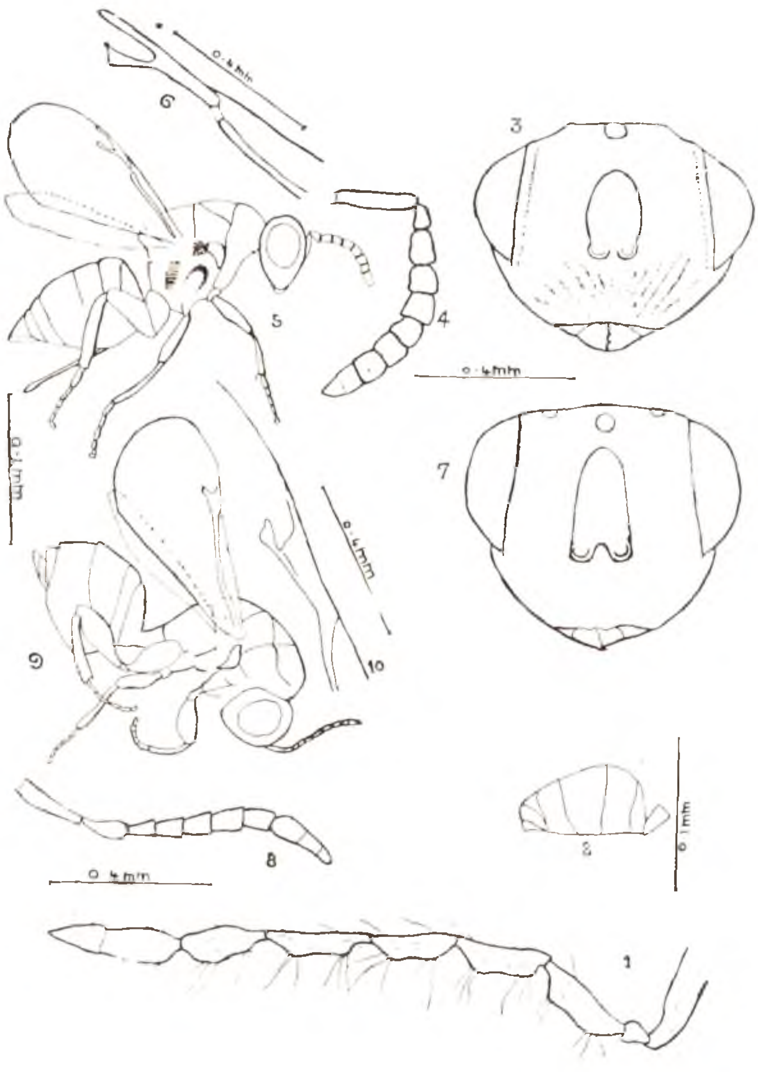
Bephratoides Brues, 1908, *Wisconsin Nat. Hist. Soc. Bul.* 6 : 158. Type-species: *Bephratoides maculatus* Brues; by monotypy and original designation.

As in the case of *Aximopsis*, this genus is also distributed in the Oriental as well as Nearctic realms. The hosts of Nearctic species are wood-boring beetles. In this genus, antennal scapes slightly exceed level of vertex, propodeum has a median furrow and gaster is compressed.

6. Bruchophagus Ashmead

Bruchophagus Ashmead, 1888, *Entomol. Amer.* 4 : 42. Type-species: *Bruchophagus borealis* Ashmead; designated by Ashmead 1894, *Trans. Am. Ent. Soc.* 21 : 328.

The genus is world wide in distribution. Most species are phytophagous in leguminous seeds. *B. mellipes* Gehan has been reported from pods of red gram from Coimbatore (Mani, 1938. *B. ollenbachi* Mani & Kaul is another species reported from India (Mussoorie) by Mani *et al.* (1974). An undescribed species has been collected by the present author from Malabar (For want of enough material the same is not described here). In this genus antennae are inserted slightly below centre of frons and apex of scape never reaches level of vertex. *Systolodes* Ashmead is a synonym of *Bruchophagus* Ashmead.



Figs. 1—2 *Acantheyrytoma spinifera* Cameron, ♂: 1. antenna, 2. gaster with petiole. Figs. 3—6. *Desantisca palanichamy* sp. nov. ♀ : 3. head; 4. antenna; 5. body; 6. forewing venation. Figs. 7—10. *Sycophila peterseni* sp. nov, ♀ : 7. head 8. antenna; 9. body; 10. Forewing venation.

7. Buresium Boucek

Buresium Boucek, 1970, *Boll. Lab. Ent. agrar. F. Silvestri Portici*, 27 : 27—54. Type-species: *Buresium rufum*.

The genus was first described from Southern Europe and Azerbaidzhan with one species. Later Zerova (1976) reported it from Tadzhikistan (USSR). Recently Boucek (1983) described a new species from India, Pakistan and Thailand. He also described another species from South Africa. The most important diagnostic feature of this genus is the presence

of a funnel-like depression on the lateral panel of pronotum. According to Boucek (1983) this funnel-like depression has some role in respiration before its emergence from the pupa. *B. naso* Boucek is parasitic on *Mordellistena* beetle.

8. Desantisca Burks

Desantisca Burks, 1971, *Trans. Am. Ent. Soc.* 97 : 37—38. Type-species: *Eurytoma latrodecti* Fullaway, 1952, *Hawaii Entomol. Soc. Proc.* 15 : 35.

Apart from Oriental region, this genus occurs in Ethiopian, Australian and Neotropical regions also. So far known, the members of this genus have been reported as parasitic in the egg sacs of spiders of the genus *Latrodectus*. In this paper a new species of this genus parasitic in the egg sacs of the spider *Cyrtophora cicatrosa*, is described below.

Desantisca palanichamyi sp. nov. (Figs. 3—6).

Female: Length 1.7 to 2.1 mm. Black; head and thorax with short, pale white pubescence; antennae, fore and mid tibiae, all tarsi, apices and bases of fore and mid coxa, apices and bases of hind tibiae brownish; wings hayaline.

Head (Fig. 3) with dense umbilicate punctures which on lower face confluent into grooves separated by raised striae radiating from area near mouth. Frons slightly convex but not bulging; scrobe deep, its margins moderately carinate; preorbital carinae weak; pubescence sparse on frons; malar sulcus absent; interocellar distance a trifle longer than twice the ocellocular distance; interocular space a trifle over twice interocellar distance. Antenna as in Fig. 4; scape not reaching front ocellus. Thorax densely puncate; anterior margin of pronotum ecarinate, sides rounded; mesoscutum a trifle wider than twice its length; tegula (Fig. 5) with umbilicate punctures; scutellum length subequal to its width, apex rounded. Propodeum flat, microsculptured. Forewings and venation as in Figs. 5 and 6. Gaster petiolate; petiole distinctly wider than long; gastral tergites smooth with sparse pubescence on sides of fifth and sixth tergites.

Male: Length 1.42 to 1.76 mm. Similar to female except in having more dense pubescence on frons, distinctly longer petiole, longer pubescence on antennae and gaster more or less blunt.

Holotype: ♀ (card mounted), INDIA: TAMIL NADU, Palani, 1982, Palanychamy, emerged from the egg sacs of *Cyrtophora cicatrosa*. **Paratypes:** 8 ♀♀ and 3 ♂♂, same data as for Holotype.

Comments: D. palanichamyi resembles *D. latrodecti* in general appearence, but differs from it in having different measurements of antennal segments, different venation, different length of petiole, and in different sizes of gastral tergites. This new species is named after Prof. S. Palanichamy of A. P. College of Arts and Culture, Palani, who collected this species.

9. Endobia Erdos

Endobia Erdos, 1964, *Bull. Soc. Ent. Fr.* 69 : 89—101. Type-species: *Endobia donacis* Erdos. Monotypy and original designation.

The genus is originally described from Southern France, Later Boucek (1983) reported it from India, Burma and Thailand. He also redescribed the genus and reported that the host of this genus is bostrychid beetle *Dinoderus* sp. The genus is characterised with an unusually

long first funicular segment in each antenna. The basitarsus of all tarsi is also unusually long in this genus.

10. Eurytoma Illiger

Eurytoma Illiger, 1807, *Fauna Etrusca*, ed. 2, v. 2: 128. Type-species : *Chalcis abrotani* Panzer (= *Pteromalus appendigaster* Swederus); designated by Westwood, 1840, *Introd. Mod. Class. Ins.*, v. 2, suppl., 66.

This is the largest genus of the family with more than a hundred species distributed all over the world. Taxonomically its limits are difficult to assess. For the same reason its generic features cannot be described without exceptions. While many species are entomophagous, some are undoubtedly phytophagous. The following species are found in the Indian subcontinent : *albotibialis* Ashmead, *angustula* Motschulsky, *chrysothrix* Waterston, *contraria* Walker, *denticoxa* Gahan, *dentipectus* Gahan, *gracilis* Motschulsky, *hindupurensis* Gahan, *indefensa* Walker, *indi* Girault, *maculipes* Motschulsky, *mitsakura* Ashmead, *pallidiscapus* Cameron (probably this species may fall under synonymy with *albotibialis*, *parasae* Gahan, *pigra* Girault, *samsonowi* Vasiljev, *setitibia* Gahan, and *taprobanica* Westwood. Several species including a few probably undescribed species are collected by the present author from Malabar. The genera viz. *Decatoma* Spinola, *Ennetoma* Dahlbom, *Enneatoma* Dalla Tore and *Bephratella* Girault are synonyms of *Eurytoma* Illiger.

11. Mesoeurytoma Cameron

Mesoeurytoma Cameron, 1911, *Soc. Entomol.* 26: 28. Type-species : *Mesoeurytoma cariniceps* Cameron; by monotypy.

This genus is described from specimens from Borneo. Its hosts are unknown. Cameron also described another genus *Stireurytoma* in the same paper based on male specimens from Borneo, Gahan and Burks pointed out (Burks, 1971) that these males of *Stireurytoma* are almost certainly the males of *Mesoeurytoma*. The types are present in the British Museum of Natural History, London. In *Mesoeurytoma* scapes almost reach level of vertex. Propodeum is deeply and broadly concave. Gaster is compressed.

12. Philolema Cameron

Philolema Cameron, 1908, *Deutsh. Entomol. Ztschr.* p. 560. Type-species : *Philolema carinigena* Cameron; by monotypy.

This genus is originally described from Borneo. It includes only its type-species. Its host is reported as leaf beetle *Lema* Fabricius. In this genus the following characters are seen in addition to the features mentioned in the key below : Malar furrow absent: propodeum deeply concave; gaster compressed with third tergite longer than fourth.

13. Prodecatoma Ashmead

Prodecatoma Ashmead, 1904, *Mem. Carnegie Mus.* 1 : 261—263. Type-species : *Prodecatoma flavescens* Ashmead; original designation.

This genus occurs in Oriental, Ethiopian, Neotropical and Nearctic regions. Many species have been reared from seeds and from plant galls. In this genus, face is with numerous strong carinae converging on mouth opening. Scrobe contains the front ocellus in this genus. Other features include the following: scapes exceed the level of vertex; gaster compressed with fourth tergite longest. Indian species include *P. sabiae* Mani, *P. beesoni* Mani and Kaul and *P. bhatiai* Mani and Kaul (Mani *et al.*, 1974).

Through the kindness of Dr. E. E. Grissel of U. S. National Museum, Washington D. C. I could examine the Holotypes of *P. beesoni* and *P. bhatiai.* The type (female) of *P. beesoni* lacked parts of legs and antennae. I am not quite sure whether this species really belongs to *Prodecatoma* since the marginal vein of forewing is enlarged in this specimen. It comes very near *Agriotoma* Burks but for the longer post-marginal. The generic status of *P. bhatiai* is also doubtful. The Holotype (male) has its front ocellus not clearly and not undoubtedly situated inside the scrobe. It may be a male *Eurytoma.*

14. Risbecoma Subba Rao

Risbecoma Subba Rao, 1878, *Proc. Indian Acad. Sci. B* 87 (12) : 298—300. Type-species : *Eurytoma bruchocida* Risbec, 1951, *Mem. Inst. fr. noire* 13 : 342.

This genus is Oriental as well as Ethiopian in distribution. It consists of only its type-species. It had been collected or reared from infested seeds of *Acacia verrek*. The diagnostic features other than those given in the key are the following : antennae inserted above level of ventral margin of eyes; propodeum vertical to scutellum; petiole as long as hind coxa in female.

15. Sycophila Walker

Sycophila Walker, 1871, *Notes on chalc.* p. 63. Type-species: *Sycophila decatomoides* Walker; designated by Ashmead, 1904, *Mem. carnegie Mus.* 1 : 389.

Considerable confusion existed regarding the various synonyms involved with reference to this genus for a long period until Boucek (1974, 1981) studied the genus in great depth and brought out clearly the synonyms involved. The following are the synonyms of *Sycophila* Walker: *Tineomyza* Rondani, *Isanisa* Walker, *Pseudisa* Walker, *Eudecatoma* Ashmead and *Decatoma* of Authors not of Spinola. The species of *Sycophila* occur in the Oriental as well as Nearctic realms. They live in figs as inquilines. An interesting new species which differs distinctly from all the other related species has been collected from Malabar by the present author and the same is described below.

Sycophila peterseni sp. nov. (Figs. 7—10)

Female: Length 1.27 to 2.05 mm. Predominently black with shoulders yellowish-red; antennae pale yellow; propleura and mesopleura pale red (this pale reddish colouration is variable to reddish-black); Legs pale yellowish-brown. Wings hayaline with fuscous marginal vein. Pubescence pale yellow to dirty white.

Head (Fig. 7) finely reticulate with shallow semi-umbilicate punctures; pubescence short, subdecumbent, longer and more erect only at mouth area. When measured from vertex, interocellar distance a little more than four times ocellocular distance; interocular space at its shortest distance a little over twice interocellar distance. Antennae as in figure 8; scape not at all reaching front ocellus. Thorax with umlicate, shallow and dense punctures; pubescence short and almost decumbent; pronotum weakly carinate at lateral margin: mesoscutum a trifle shorter than scutellum; scutellum 1.5 times as wide as long; propodeal surface finely sculptured and with a median depression; hind tibia with a row of eight to ten dorsal bristles. Forewing and venation as in Figs. 9 and 10. Gastral tergites smooth and polished.

Male: Unknown.

Holotype: ♀ (card mounted), INDIA:

KERALA, Calicut University Campus, 5.ii.1981, T. C. NARENDRAN.

Paratypes: 2 ♀♀ same data as for holotype. Host unknown. This new species is named after Dr. Borge Petersen of Universitetets Zoologiske Museum, Copenhagen for co-operation in the studies on chalcid wasps by the present author.

Comments: This new species does not come close to any of the species described from the Indian subcontinent by Walker (1871), Joseph and Abdurahiman (1968) and Motschulsky (1863). However *S. pictum* described by Boucek (Boucek *et al.*, 1981) from Africa shows resemblance to this undescribed species in having somewhat similar colouration and in having the pedicel longer than first funicular segment and at the same time differs from *S. peterseni* in having the exposed part of prepectus with hairs, pubescene absent from central area of scutellum, gaster distinctly compressed and in having the gastral tergites with extremely fine and sparse striae. The species *deobanensis* described by Mani and Kaul (Mani *et al.*, 1974) under the generic name *Eudecatoma* is not at all close to *S. petersieni*. I am doubtful about the generic status of *deobanensis*. I examined the **Holotype** of this species (a male) and in this type the antennae are plumose cheeks are carinate laterally and front ocellus is situated inside the scrobe. In any case this species does not belong to the genus *Sycophila* (= *Eudecatoma*).

16. Systole Walker

Systole Walker, 1833, *Ent. Mag.* 1:13,22. Type-species: *Systole albipennis* Walker; by monotypy.

The genus is cosmopolitan in distribution. Members of this genus are usually found in the seeds of umbelliferae. In this genus the following additional features are seen: antennal scape not quite reaching front ocellus; petiole not visible in undissected specimens: gastral tergites one to five subequal in length.

17. Tetramesa Walker

Tetramesa Walker, 1848. *List. Spec. Hym. Ins. Brit. Mus.*, Chalc., pt. 2:10. Type-species: *Tetramesa iarbas* Walker; by monotypy.

Much controversy existed among the various chalcidologists regarding the synonymy invoved with *Tetramesa* Walker and *Harmolita* Motschulsky. This problem is discussed in a separate paper (Narendran, 1983) according to which *Tetramesa* is the latest accepted name and *Harmolita* is its synonym. This genus is world-wide in distributiou. Almost all members are phytophagous. Some of the species are gall makers. In this genus the position of the front ocellus is not very stable as it is not clearly located above or within scrobe since dorsal margin of scrobe is very vague in most species. *Tetramesa indica* (Mani and Kaul) (com. nov.) and *T. longicornis* (Motschulsky) are reported from India (Mani *et. al*, 1974) and from Sri Lanka (Mani, 1938) respectively. An unconfirmed species (probably undescribed) is found abundantly in the Malabar region. The other synonyms of *Tetramesa* are the following: *Isosoma* Walker, *Philachyra* Walker, *Xanthosoma* Ashmead, *Isosomocharis* Ashmead, *Urios* Girault, *Exanthosoma* Girault, *Isthmosoma* Hedicke, and *Ahtola* Claridge.

KEY TO GENERA OF ORIENTAL EURYTOMIDAE

1. Lateral panel of pronotum with characteristic funnellike depression (Boucek, 1983, Figs. 6, 7, 9)....... *Buresium* Boucek

—Lateral panel of pronotum without such funnel-like depression................ 2

2. Forewing stigmated and usually with marginal enlarged and shaded posteriorly 3

—Forewing not stigmated.............. 4

3. Anterior ocellus located within scrobe; antennae inserted at the centre of frons, above level of ventral margin of compound eyes; umbilicate punctures of pronotum with elevated anterior margins; ovipositor greatly produced posteriorly, at least half as long as gaster. ....*Agriotoma* Burks

—Anterior ocellus located outside scrobe; antennae inserted below centre of frons at or slightly above level of ventral margins of compound eyes; lateral margins of cheeks acarinate or with very slight carinae near mandible...... ....*Sycophila* Walker

4. Scutellum with a long spine projecting posteriorly from the posterior margin ....*Acantheurytoma* Cameron

—Scutellum without a spine projecting posteriorly as above.................... 5

5. Lateral margins of cheeks carinate...... 6

Lateral margins of cheeks not carinate, at the most with carinate margin at base only....................................14

6. Each hind coxa with a broad dorsolateral longitudinal carina; petiole almost square in cross-section and with a prominent ridge on dorsal surface; anterior ocellus located within scrobe.......... ....*Aximopsis* Ashmead

—Not having above combination of characters.. 7

7. Frons broadly concave, resembling *Anteriocephalus* Kirby, with strong preorbital carinae and with transverse carina behind anterior ocellus................... 8

—Frons not broadly concave, not resembling *Antrocephalus* Kirby................ 9

8. Anterior margin of pronotum carinate but interrupted in the middle to form two vague teeth; tranverse carina on vertex interrupted in the middle; gaster ovate with the fourth tergite longer than any other tergites............. *Mesoeurytoma* Cameron

—Anterior margin of pronotum ecarinate; transeverse carina on vertex not interrupted in middle, gaster compressed with third and fourth tergites subequal in length................. *Philolema* Cameron

9. Anterior ocellus situated within scrobe, at the most separated by a transverse carina 10

—Anterior ocellus situated outside scrobe 11

10. Occiput prominently concave; fore femur swollen with or without teeth on ventral margin; pronotum usually long, narrowed posteriorly and with large punctures in the middle region *Bephratoides* Brues

—Occiput not prominently concave; fore femur not swollen as above, at the most slightly enlarged; pronotum more transeverse................*Prodecatoma* Ashmead

11. Tegula with characieristic umbilicate punctures (Fig. 5); antenna with six funicular segments (Fig. 4) and vaguely two-segmented club......*Desantisca* Burks

—Not having the above combination of characters; tegula never with umbilicate punctures 12

12. Head almost round in anterior aspect; interantennal projection strongly produced anteriorly; gaster elongate and linear, compressed basally with first tergite forming a hump in lateral aspect............................*Banyoma* Burks

—Not having the aboxe combination of characters; interantennal projection not produced anteriorly; gaster not elongate and linear 13

13. Propodeum vertical or nearly vertical, flat or broadly concave, without a median furrow; third and fourth gastral tergites subequal in length on dorsal middle region; petiole very short, always wider than long...........*Bruchophagus* Ashmead

—Propodeum usually sloping with median furrow present; fourth gastral tergite longer than any others, occupying less than half dorsal length of gaster, petiole varying from as long as hind coxa to verv short as to be visible only in dissected specimens...................*Eurytoma* Illiger

14. Anntenna with first funicular segment unusually long: (as long as combined length of 3 following segments) and apex enlarged.................*Endobia* Erdos

—Antenna not as above 15

15. First gastral tergite longest, second about half the first and the rest very small and subequal: median longitudinal furrow on propodeum absent: cheeks carinate only basally..*Risbecoma* Subba Rao

—Not having the above combination of characters 16

16. Propodeum sloping posteriorly with median longitudinal furrow present; anterior angles of pronotum usually with light colour markings; antennal scape reaching or slightly exceeding the level of vertex; prescutum as long as or longer than scutellum.................
.... *Tetramesa* Walker

—Propodeum usually vertical; anterior angles of pronotum without light colours; antennal scape not quite reaching level of vertex; prescutum shorter than scutellum....................*Systole* Walker

For practical reasons the genera are here arranged alphabetically.

Acknowledgements: I am grateful to Dr. E. E. Grissel of the U. S. National Museum of Natural History, Washington, D. C. who helped me to examine the necessary types of several genera present in the U. S. National Museum. I am thankful to Dr. John S. Noyes of the British Museum (Natural History), London, for cooperation in the identification of *Desantisca palanichamyi*. I express my gratitude to Dr. Z. Boucek of Commonwealth Institute of Entomology, London, for useful discussions on various families of Chalcidoidea during my study stay at the British Museum (Natural History), London, which was of help in the preparation of this paper. I thank Dr. Kumar D. Ghorpade of the University of Agricultural Sciences Bangalore for sending several xeroxed copies of some research papers for my use. Finally I thank Professor K. J. Joseph, Head of the Deprtment of Zoology, University of Calicut, for sparing a few of the reprints of this earlier papers.

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BRIEF COMMUNICATION

NEW OFF-SEASON SUMMER HOSTS OF THE GROUNDNUT LEAF MINER, *APROAEREMA MODICELLA* DEVENTER, (=*STOMOPTERYX SUBSECIVELLA* ZELL.) (LEPIDOPTERA: GELECHIIDAE) IN ANDHRA PRADESH

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(Received 22 May 1983)

Two weed plants viz., *Rhychosia minima* Dc. (Leguminoseae) and *Boreria hispida* K. Sch. (Rubiaceae) were recorded for the first time as off-season summer hosts for the groundnut leaf miner. The caterpillars behaved exclusively as leaf miners on *Indigofera hirsuta* L. (Leguminoseae), another off-season host plant, during November—December.

(Key words: weed hosts, *Rhyncosia minima*, *Boreria hispida*, groundnut leaf miner)

A survey was undertaken in Andhra Pradesh at and around the S. V. Agricultural College farm at Tirupati, to identify plants which serve as alternate hosts for the groundnut leaf miner, *Aproaerema modicella* D., during April—July 1982, the off-season for groundnut cultivation. This survey revealed that a leguminous creeper, *Rhynchosia minima* Dc., was supporting this pest. Numerous leaf mines and webs with caterpillars inside were found on this plant. The caterpillars and the moths that emerged later, were identified as *A. mod cella.* The pest could be successfully reared for two generations on this plant *(R. minima)* under laboratory conditions. The weed, *R. minima* was widely distributed around Tirupati particularly on the field bunds and uncultivated waste lands adjoining the cultivated areas. So far, *A. modicella* has not been reported on *R. minima* and this is the first report.

Pupae of *A. modicella* were collected from the leaf webs of another common dryland weed, *Boreria hispida* K. Sch., (Rubiaceae) also, indicating the possible role of this plant, as an alternate host for the leaf miner. This is also the first report of a non-leguminous plant as a host for *A. modicella.*

Hitherto, among the cultivated crops and weeds, pigeon pea, greengram, lucerne, *Psoralea corylifolia* L., *Indigofera hirsuta* L., *Phaseolus calcaratus* Roxb., *Glycine soja* and five other wild plants, all belonging to Leguminoseae, have been reported as alternate hosts for *Aproaerema modicella* (Mohammad, 1981).

The groundnut leaf miner was found abundantly on *Indigofera hirsuta* during November—December 1982, in the S. V. Agricultural College Farm at Tirupati in the absence of the principal host, the groundnut. It is probably from *I. hirsuta* that the pest migrates to the *rabi* groundnut crop, sown in December—January. It was also observed that the pest only as a leaf miner on *I. hirsuta*

unlike on groundnut, where the caterpillars spend early part of their life cycle as miners and remaining part as webbers. This peculiarity in the feeing behaviour of the caterpillars on *I. hirsuta* needs further investigation.

Acknowledgement: The authors express thanks to Associate Director of Research, National Agricultural Research Project, S. V. Agricultural College, Tirupati for the facilities provided and also to Mrs. M. Mahalakshmi, Assistant Professor in Genetics and Plant Breeding for identification of the weed plants.

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Entomon, 1984, *Vol.* 9, *No.* 1, *pp.* 13 *to* 14

BRIEF COMMUNICATION

TWO HITHERTO NOT KNOWN MORPHS OF *MACROSIPHUM PSEUDOGERANII* CHAKRABARTI AND RAYCHAUDHURI (HOMOPTERA : APHIDIDAE)

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(Received 9 July 1983)

Undescribed alate viviparous female and alate male of *Macrosiphum pseudogeranii* Chakrabarti and Raychaudhuri are recorded and described from Garhwal range of north west India.

(*Key words: Macrosiphum pseudogeranii*, undescribed alate viviparous female, alate male)

Macrosiphum pseudogeranii Chakrabarti and Raychaudhuri

Chakrabarti and Raychaudhuri (1974) proposed *Macrosiphum pseudogeranii*, a *nomen novum* for the species which was originally described by Chowdhuri *et al.*, (1969) as *Macrosiphum geranii* from apterous viviparous females only. Later, Raychaudhuri *et al.* (1980) described apterous oviparae of this species. So, hitherto not known alate viviparous female and alate male are described here.

Alate viviparous female: Body about 3.12 mm long with 1.16 mm as maximum width. Head pale brown, dorsum with 11 pairs of hairs, longest one on vertex about 1.42 times the basal diameter of antennal segment III. Antennae about 1.34 times the body; processus terminalis 6.50 times the base of the segment VI, segment III with 19—21 secondary rhinaria distributed on the entire segment except the basal 0.11—0.12 and apical 0.15—0.19 portion; longest hair on antennal segment II about 1.14 times the basal diameter of the segment. Rostrum reaching mid-coxae, ultimate rostral segment about 1.11 times the second joint of hind tarsus. Abdomen pale, smooth; dorsal hairs with fine apices, 7th & 8th tergites with 12 long hairs, longest one on these segments about 1 85 times the mentioned diameter. Siphunculi about 0.20 times the body and 2.0 times the dusky cauda. Wing venation normal. Other characters as in apterae.

Measurements of the specimen in mm: Body length 3.12, width 1.16, antenna 4.19, antennal segments III : IV : V : VI: 0.97 : 0.79 : 0.64 : (0.19 + 1.29); ultimate rostral segment 0.16; second joint of hind tarsus 0.14; siphunculus 0.63; cauda 0.31.

Alate male: Body 2.77 mm long with 1.02 mm as maximum width. Head dark dorsum slightly rugose, with 4 pairs of hair, longest hair on vertex about 0.80 times the basal diameter of antennal segment III. Antennae dark brown except the very base of segment III, about 1.60 times the body; processus terminalis about 7.66 times the base of segment VI; segment III with 51—46, IV with 21—23.

With 19 secondary rhinaria, longest hair on segment III about 0.60 times the basal diameter of the segment. Ultimate rostral segment about 0.89 times the second joint of hind tarsus and with 3 pairs of secondary hairs. Abdominal dorsum with brown spinal, pleural and marginal sclerites on tergites 1—2, while on tergites 4—6 brown sclerites fused to from a broken patch, longest hair on anterior abdominal tergites about as long as the basal diameter of antennal segment III, 7th tergite with 8 hairs and 8th tergites with 6 hairs, longest hair on these tergites about 1.40 times and 1.70 times the mentioned diameter, respectively. Siphunculi dark, apical 0.30 portion reticulated, about 0.17 times the body and 2.23 times the pale cauda which bears 8 hairs. Male genitalia well developed, claspers with a process at their base. Other characters as in alate female.

Measurments of the specimen in mm: Body length 2.77, width 1.02; antenna 4.44; antennal segments III : IV : V : VI: 0.86 : 0.86 : 0.74 : (0.19 + 1.52); ultimate rostral segment 0.14; second joint of hind tarsus 0.16; siphunculus 0.48; cauda 0.21.

Materials examined: Many apterous viviparous females, 1 alate viviparous female and nymphs, India; Uttar Pradesh, Mussoorie (*c* 2004 m), 17.x.76. 3 apterous viviparous females, 1 alate male and nymphs, Mussoorie 3.xi.1977 from *Geranium nepalense* (Coll. S. P. Maity).

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Entomon, 1984, *Vol.* 9, *No.* 1, *pp.* 15 *to* 17

PERSISTENT TOXICITY OF CERTAIN INSECTICIDES TO JASSID *AMRASCA BIGUTTULA BIGUTTULA* (ISHIDA) ON BRINJAL*

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(Received 28 February 1983)

Persistent toxicity of four insecticides, fenitrothion, phenthoate, quinalphos and fenvalerate was studied against second instar nymphs of *Amrasca biguttula biguttula* (Ishida) in greenhouse as well as in the field. The test insects were confined on the treated leaf surface using a microcage designed for the purpose and the mortality of the insects recorded daily. The results indicated that fenvalerate 0.04% had high initial and prolonged persistent toxicites followed by fenvalerate 0.02%, phenthoate 0.1%, quinalphos 0.1% phenthoate 0 05% and fenitrothion 0.1%. Quinalphos and fenitrothion at 0.05% were found relatively less toxic.

(*Key words:* residual toxicity, insecticides, jassid, *Amrasca biguttula biguttula* (Ishida), brinjal)

Jassid is one of the important pests of brinjal, sucking cell sap and transmitting the "little leaf" disease on brinjal (THOMAS & KRISHNASWAMI, 1940). Several insecticides have been recommended for the control of this pest. But detailed studies on the persistent toxicity of insecticides is meagre. Hence these studies were taken up.

MATERIAL AND METHODS

Greenhouse and field experiments were conducted during 1978 at Indian Agricultural Research Institute, New Delhi. The insecticidal treatments were fenitrothion, phenthoate and quinalphos at 0.05 and 0.1% and fenvalerate at 0.02 and 0.04% concentrations.

Fifty day old potted brinjal plants, one in each pot free of insect infestation were selected. Each treatment was replicated thrice. The spray fluids were prepared using commercial formulations. The potted plants were sprayed with the respective insecticidal spray fluid by means of one litre sprayer taking care that the plants were thoroghly and uniformly covered with spray fluid. The second instar nymphs of jassid collected from untreated brinjal plants were conditioned in the laboratory and used for the experiments. When the spray fluid got dried up, ten jassid nymphs were released and confined on the ventral surface of one of the leaves by enclosing them in microcage. The mortality of jassid was recorded daily. The moribund insects also were considered dead. After recording the data, all the nymphs (dead/alive) were removed and a fresh batch of ten insects was released in each microcage. The exposures were continued till there was no mortality in any of the replications cansecutively for two days. The mortality data were corrected with Abbott's formula (ABBOTT, 1925). The corrected mortality data were subjected to probit analysis (FINNEY, 1952) for assessing LT_{50} values and PT index (SAINI, 1959; PRADHAN & VENKATARAMAN, 1962) expressing the persistent toxicity of the insecticides also was worked out.

* Part of the Ph.D. thesis submitted to P G School, I A R I., New Delhi by the senior author.

Table 1. Persistent toxicity of insecticides to jassid, *A. biguttula biguttula.*

Insecticides	Conc. (%)	No. of days for which 100% mortality observed	Period of toxicity in days (P)	Average toxicity (T)	Index of persistent toxicity (PT)	Heterogeneity	Regression equation	LT_{50} (days)	Fiducial limits
					In field conditions				
Fenitrothion	0.05	6	20	71.65	1433.07	X^2 (3) = 4.637	y = 34.510—7.060 X	15.13	16.24—14.10
Fenitrothion	0.10	8	24	69.80	1675.09	X^2 (3) = 0.136	y = 28.569—5.560 X	17.34	18.75—16.03
Phenthoate	0.05	7	25	70.77	1769.28	X^2 (4) = 0.257	y = 33.089—6.550 X	19.43	20.75—18.20
Phenthoate	0.10	9	29	72.67	2107.40	X^2 (3) = 0.046	y = 40.742—8.243 X	21.67	22.67—20.71
Quinalphos	0.05	6	21	70.52	1480.86	X^2 (3) = 0.239	y = 31.680—6.350 X	15.91	16.95—14.93
Quinalphos	0.10	10	26	73.43	1909.26	X^2 (3) = 0.106	y = 45.833—9.484 X	20.20	21.20—19.21
Fenvalerate	0.02	16	34	76.69	2667.44	X^2 (3) = 0.055	y = 40.688—8.045 X	27.28	28.99—25.66
Fenvalerate	0.04	19	39	76.93	3000.25	X^2 (3) = 0.047	y = 48.579—9.720 X	30.44	32.07—28.91
					In greenhouse conditions				
Fenitrothion	0.05	3	14	65.03	900.46	X^2 (3) = 1.170	y = 42.700—9.360 X	10.72	11.72— 9.79
Fenitrothion	0.10	4	19	59.87	1137.58	X^2 (3) = 1.800	y = 25.844—5.144 X	11.27	12.34—10.30
Phenthoate	0.05	5	18	63.56	1144.09	X^2 (3) = 0.089	y = 31.287—6.485 X	11.31	12.04—10.60
Phenthoate	0.10	7	22	62.74	1380.37	X^2 (4) = 0.106	y = 27.323—5.408 X	13.42	14.55—12.38
Quinalphos	0.05	4	15	65.07	976.10	X^2 (3) = 0.015	y = 23.030—4.500 X	10.16	11.23— 9.18
Quinalphos	0.10	6	19	66.06	1255.19	X^2 (3) = 0.325	y = 36.851—7.777 X	12.46	13.26—11.69
Fenvalerate	0.02	10	28	75.74	2121.86	X^2 (3) = 0.074	y = 44.593—9.131 X	21.68	22.69—20.72
Fenvalerate	0.04	16	32	77.73	2487.38	X^2 (4) = 0.087	y = 41.372—8.250 X	25.64	27.66—23.75

RESULTS AND DISCUSSION

Perusal of data (Table) indicates that fenvalerate 0.04% had persistent toxicity for longer period against jassid compared to all other treatments as the PT (3000.25 and 2487.38) and LT_{50} (30.44 and 25.64 days) valus were very high under greenhouse and field conditions. Fenvalerate 0.02% was the next best treatment as evident from high PT indices (2607.44 and 2121.86) and LT_{50} values (27.28 and 21.68 days). The other treatments in decreasing order of persistent toxicity were phenthoate 0.1%, quinalphos 0.1%, phenthoate 0.05% and fenitrothion 0.1%. Quinalphos and fenitrothion at 0.05% were found to be relatively less persistent. However these two treatments gave more than 50% mortality of the pest for 15.91 and 15.13 days in green house and 10.16 and 10.72 days in the field respectively. The high LT_{50} value of fenitrothion 0.05% observed in the present investigations might be that the toxicity was tested against nymphs.

The LT_{50} values of different insecticidal treatments indicate that the persistence of residual toxicity was not very high at higher concentration as compared to its lower concentration both in greenhouse and in the field. This is in conformity with the findings of GERA & CHOPRA (1975) who reported that increase in the concentration of insecticides do not give better effect on their persistence. This shows that lower concentration is sufficient to get good control of the pest for reasonable length of period.

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Entomon, 1984, *Vol.* 9, *No.* 1, *pp.* 19 *to* 24

EFFECTS OF DIFLUBENZURON AND PENFLURON ON THE REPRODUCTIVE POTENTIAL OF THE ORIENTAL FRUIT FLY, *DACUS DORSALIS* HENDEL (DIPTERA: TEPHARITIDAE): INFLUENCE OF AGE AT THE TIME OF TREATMENT ON STERILITY

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Diflubenzuron and penfluron induced complete sterility in either sex of *Dacus dorsalis*, when applied topically to newly emerged flies at a dose of 5μg/fly. However, the recovery of fertility was recorded as the post-treatment days increased. In cross combinations, where either male, or female or both were treated, egg laying was delayed by 3—13 days as compared to control. Recovery of fertility was faster in diflubenzuron treated flies than penfluron treated flies. Also, the flies treated at emergence, remained sterile for longer period than the flies treated at maturity. Per cent egg hatch and corrected per cent sterility in the flies treated at maturity for the Ist and subsequent three weeks and per cent egg hatch of successive egg batches in the flies treated on emergence showed that penfluron was more effective than diflubenzuron.

(Key words: diflubenzuron, penfluron, chitin synthesis inhibitors, *Dacus dorsalis*, corrected per cent sterility and fecundity)

INTRODUCTION

The discovery of about 200 urea derivatives (WELLINGA *et al.*, 1973 a, b) as ovicides and larvicides interfering with moulting and cuticle deposition of insects, directed the attention of researchers towards the adventages of these compounds over mutagenic agents and encourged them to screen new compounds to find out suitable sterilants. With these compounds a new type of population suppression has been achieved by combining insecticidal activity in immature insects with sterilizing activity in adults.

Diflubenzuron has been found to cause reduction in egg hatch (WRIGHT & SPATES, 1976), no reduction in egg hatch (IVIE & WRIGHT, 1978) and complete absence of egg hatch in a few first egg batches, while gradual increase in subsequent egg batches (CHANG, 1979) of house flies. To see the above controversial effects and excellent ovicidal and larvicidal activities of diflubenzuron and penfluron in insects (WELLINGA *et al.*, 1973 a, b; OLIVER *et al.*, 1977), the effects of these two compounds were studied on the oriental fruit fly in the present investigation. Also an attempt has been made to know what influence age at the time of treatment would have on the ease with which sterility could be induced with minimum adverse effects.

MATERIALS AND METHODS

Adult flies were collected from cucurbit

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plants and were reared in plastic jars covered with Muslin cloths at $27 \pm 2°C$ and 70% RH. Photophase and scotophase (each of 12h) were given. Artificial diet of glucose and protenules in equal proportion was provided. Water was given in injection vials, plugged with cotton wool and hung downward in containers of flies with the help of threads and rubber bands. Water and food were replaced after two days. Matured flies were induced to lay eggs by hanging a thinly sliced piece of pumpkin in containers of flies. Eggs were transferred to a large piece of pumpkin with a brush. About 100 eggs were kept in each container to avoid overcrowding. Eggs were incubated at $27 \pm 2°C$. After two or three days when larvae started developing rapidly, fresh pumpkin pieces were supplied to them as larval food. Fluid, which oozed out of used pumpkin, was removed daily to protect the delicate larvae from dying. When larvae reached prepupal stage, they were transferred along with their media to a plastic jar filled one fourth with sterilized sand which served as pupation media for pupating larvae. Just after emergence, flies were sexed. Flies were used for tests after 5—6 generations when they were fully acclimatised to the laboratory conditions.

The 0.5% solution of each test compound was prepared in acetone just before use. Newly emerged (0—24h old) and sexually matured (13—16 days old) flies were first anesthetised by chilling treatment and then 1µl solution of test compound was applied per fly on the ventral surface of abdomen with the help of micrometer controlled calibrated syringe. Control flies were treated with the same amount of acetone alone. In order to determine the effectiveness of test compound as sterilant, different cross combinations (T♂ × T♀, T♂ × U♀, T♀ × U♂ & U♂ × U♀; T = Treated, U = Untreated) were examined at maturity for fecundity of female and per cent range and average of egg hatch in successive egg batches (where flies were treated on emergence) for 90 days. Three replicates were studied in each cross combination. Corrected per cent sterility in the flies treated at maturity for Ist and subsequent three weeks was calculated according to CHAMBERLAIN (1962) as follows:

$$\text{Corrected \% sterility} = \frac{\text{\%egg hatch in control} - \text{\%egg hatch in treated}}{\text{\% egg hatch in control}} \times 100$$

Five replicates were studied at each cross combination. The data obtained were analysed statistically according to Duncan's new multiple range test (1955).

RESULTS AND DISCUSSION

In the cross combinations where either male or female or both were treated with penfluron or diflubenzuron, egg laying was delayed by 3—13 days as compared to control. This may be due to inhibitory effects of compounds on gonadial development. SAXENA & VINOD (1982), observed a significant fall in oviposition and complete sterility in *Trogoderma granarium* with these compounds. The range and average hatch of successive egg batches laid by the flies treated with penfluron and diflubenzuron at emergence have been depicted in Tables 1 & 2. Among the laid eggs, a few first egg batches did not hatch, while the hatch of subsequent egg batches increased as the post treatment days increased. This finding is in complete agreement with that of CHANG (1979). Flies treated with penfluron and diflubenzuron remained completely sterile (no egg hatch) for as many as 66, 34, 39 and 35, 28, 30 days in the cross combinations of T ♂ × T♀, T ♂ × U♀ and U ♂ × T♀ respectively showing that penfluron was more effective sterilant than diflubenzuron. Also the comparison of range and average hatch of successive egg batches laid by the penfluron and diflubenzuron treated flies showed more effectiveness of penfluron than diflubenzuron. Per cent egg hatch and corrected per cent sterility in the first week post-treatment for penfluron and diflubenzuron were 28.57, 70.70 and 69.65, 24.9 while in the subsequent three weeks the figures for the same were 83.40 88.82 and 11.40, 5.69 respectively (Table 3), which also indicated more effectiveness of penfluron.

TABLE 1. Range and average hatch of successive egg batches laid by a single pair of fruit fly, *Dacus dorsalis* treated with penfluron on emergence (0—24h old).

Nature of cross	R.N.	1st month PT		2nd month PT		3rd month PT	
		Range in per cent	Average % egg hatch	Range in per cent	Average % egg hatch	Range in per cent	Average % egg hatch
T♂×T♀	1.	0	0	0	0	10.52–67.79	32.60
	2.	0	0	0	0	25.71–58.62	31.11
	3.	0	0	31.7–69.55	30.80	53.84–69.55	59.33
T♂×U♀	1.	0–5.71	5.71	33.33–76.5	54.54	69.23–80	71.43
	2.	0	0	0–70.58	34.09	Female died	
	3.	0	0	0–49.18	27.31	50–52.63	50.45
U♀×T♂	1.	0	0	0–18.36	13. 7	16.4–70	34.48
	2.	0	0	0–53.57	37. 7	53.64–81.81	64.93
	3.	0	0	0–51.85	28.62	57.84–58.62	58.33
U♂×U♀	1.	88.88–90	89.44	92.3–100	94.25	76.92–95	94.4
Control	2.	88.83–100	92.49	80–100	90.47	88.23–100	94.93

RN = Replicate number; PT = Post treatment.

TABLE 2. Range and average hatch of successive egg batches laid by a single pair of fruit fly, *Dacus dorsalis*, treated with diflubenzuron on emergence (0–24h old).

Nature of cross	R.N.	1st month PT		2nd month PT		3rd month PT	
		Range in per cent	Average % egg hatch	Range in per cent	Average % egg hatch	Range in per cent	Average % egg hatch
T♂×T♀	1.	0	0	0–51.21	28.3	50–92.85	83.58
	2.	0	0	0–71.42	41.8	50–95	76.72
	3.	0	0	0–46.66	25.5	59.45–93.1	75.82
T♂×U♀	1.	0	0	4.54–50	51.28	76.92–93.28	87.98
	2.	0–11.11	11.11	0–73.68	36.97	90.47–94.28	92.85
	3.	0	0	25–66.66	47.17	50–89.1	77.14
U♂×T♀	1.	0	0	10–66.66	45.11	80–96.77	89.6
	2.	0	0	43–44.44	43.72	73.68–90.32	91.85
	3.	0	0	14.28–73.17	43.96	46.15–70	76.38
U♂×U♀	1.	88.88–90	89.44	92.3 –100	94.25	76.22–95	94.4
Control	2.	88.83–100	92.49	80–100	90.47	88.23–100	94.93

R N = Replicate number; P T = Post treatment,

TABLE 3. Eeffects of penfluron diflubenzuron on the fertility of *Dacus dorsalis*, when mature virgin flies (16—17 days old) were treated topically with 1 μl solution of test compound (0.5%) (mean of 5 replicates).

Compound	First week post-treatment				Subsequent three weeks post-treatment	
	Sex treated	Pair crossed	Per cent egg hatch	Corrected per cent sterility	Per cent egg hatch	Corrected per cent sterility
Acetone (control)	♂, ♀	15	94.14 a	—	94.14 a	—
Penfluron	♂, ♀	15	28.57 b	69.65	83.40 a	11.40
Diflubenzuron	♂, ♀	15	70.70 c	24.90	88.82 a	5.64

The values in a column not sharing the common letter are significantly different from one another according to Duncan's new multiple range test with $\alpha = 0.01$.

Also the recovery of fertility was faster in diflubenzuron treatment than penfluron (Tables 1 & 2). More effectiveness of penfluron than diflubenzuron might be due to following factors: (i) high metabolic activity and rate of excretion in case of diflubenzuron than penfluron as reported by CHANG (1978); CHANG & WOODS (1979); (ii) at equal dose level more deposition of penfluron occur in eggs than diflubenzuron as reported by CHANG & BORKOVEC (1980); (iii) less hatch preventing dose of penfluron than diflubenzuron as observed by CHANG & BORKOVEC (1980). More effectiveness of penfluron than diflubenzuron has also been reported by CHANG (1979) in *Musca domestica* L., CHANG & BORKOVEC (1980) in *Anthonomus grandis* Boheman. In agreement with our results, boll weevils, and house flies also recovered fertility rapidly from diflubenzuron treatment (MOORE & TAFT, 1975; GROSSCURT 1976). The possible explanation may be high metabolic activity and rate of excretion in diflubenzuron treated flies than penfluron treated flies. As both the compounds are ovicides and larvicides, the sterility induced in cross combinations where only males were treated may be due to transfer of compound from males to females during copulation (BORKOVEC, 1979).

The cause for gradual recovery of fertility may be the sterilizing properties of chitin synthesis inhibitors which depend on their potentiality, interfering with embryogenesis. Thus as long as the level of compound in eggs remains high, eggs will not hatch and when the level of compound falls below a certain threshold, eggs start hatching. Similar results have been reported by BORKOVEC (1979), CHANG(1979), CHANG & BORKOVEC(1980) in house flies. The cause for inability of eggs to hatch might be due to chitin synthesis inhibiting properties of diflubenzuron and penfluron (POST & VINCENT, 1973). Also diflubenzuron has been found blocking the epidermal chitin synthetase, an enzyme, responsible in polymerisation of monomer, N-acetylglucosamine, in production of chitin (POST & MULDER, 1974). As the cuticle and mouth hooks are chitinous in nature whose development start during embryogenesis and is

completed before egg hatch, it is possible that penfluron and diflubenzuron, in the present study, have penetrated into eggs and interfered with development of cuticle and mouth hooks, rendering them less rigid and incapable of providing sufficient support to the muscles, depriving the larvae of a method to come out of embryonic envelops as the dipteran larvae use body muscles and mouth armature to rupture the vitelline membrane and chorion to escape eclosion (POULSON, 1950).

In the present investigation, it was found that sterility lasted for longer period when flies were treated on emergence as compared to flies treated at maturity (Tables 1—3). Similar results were obtained by SACCA *et al.* (1964) in house flies and KEISER *et al.* (1965) in three species of fruit flies with aziridinyl chemosterilants. The possible explanation to this phenomenon is as follow: (i) more absorption of compound through the cuticle of younger flies may occur than mature flies; (ii) rate of excretion in younger flies may be less than older flies and (iii) as the cells of gonads in younger flies are in active stages of proliferation they may be more susceptible to chemical than matured flies in which gonadial cells are not in active stages of division as reported by BORKOVEC (1966) and CAMPION (1972). But CRYSTAL & RAMIRZE (1975) reported that flies were not completly sterilized when treated on emergence, but sterility increased as the treatment was delayed. Thus, the controversy may be due to specific action of the chemical to the specific age of insects. According to CLARK & ROCKSTEIN (1964), changes occur in the structure and function of some systems of insects with age that may modify the internal environment of the organism and its susceptibility to the chemosterilants.

Acknowledgement: Authors are thankful to Dr. A. B. BORKOVEC, Chief of Insect Reproduction Laboratory, USDA, Beltsville, Maryland 20705 USA, for kind donation of chemicals.

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Entomon, 1984, *Vol.* 9, *No.* 1, *pp.* 25 *to* 29

STUDIES ON GUT CONTENT ANALYSIS OF ODONATE NYMPHS IN A FRESHWATER FISH POND AT BHAGALPUR (BIHAR)

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(Received 25 September 1982)

The paper incorporates the gut content analysis of Odonata nymphs in a freshwater fish pond at Bhagalpur (Bihar) during the period June 1979 to May 1980. The gut contents of these nymphs suggest that animal diet comprises the maximum percentage of their dietary aomponent. Algae constituted only a small percentage in their diet, although their concentration in the environmental water was found to be very high. Their selective nature of feeding for animal diet and other factors affecting larval development has also been discussed.

(Key words: gut content, Odonata nymphs, micro-crustacea, algae, aquatic insects, aquatic environment, carnivorous, herbivorous)

INTRODUCTION

Considerable work has been done on the food and feeding habits of odonate nymphs (Fischer, 1971; Pritchard, 1964; Hassan, 1976), but literature pertaining to the gut content analysis of these nymphs under field conditions is rather scanty. Therefore, in the present investigation the gut content analysis of nymphal stages of Odonata has been carried out with a view to assess their role in freshwater ecosystem in a fish pond at Bhagalpur. The pond lies in the T. N. B. College Campus, Bhagalpur (86° 57′ 13″ EL and 25° 14′ 21″ NL).

MATERIAL AND METHODS

The nymphal stages of odonates along with other aquatic insects were collected by means of an insect collecting net made of nylon cloth (mesh size 40—80/cm²) in different seasons viz., summer, monsoon, winter and spring during the perid June 1979 to May 1980. The nymphs were sorted out kllied in 80% alcohol and transferred to 3% formalin for preservation. The specimens were dissected under water or 3% formalin. The insect foregut was removed and dissected further on a glass slide. The techniques as suggested by Mecom & Cummins (1964) and Shapas & Hilsenhoff (1976) were used with some modifications to characterise feeding habits. The gut contents were counted using the method of Brown (1961). Approximate percent by volume of food items (animals, plants, and other matters) was recorded for each season. No attempt was made to analyse mid gut contents since possible misinterpretation of the source of undeterminable matter might result (ie., what appears as undeterminable matter in the midgut could have been ingested in that form, or may have resulted from proventricular action or partial digestion). Plankton of overlying water were collected by a plankton net made of bolting silk no. 25 (mesh size .03—.04 mm) and counted by Lackey microtransect method (1938).

RESULTS

Table 1 summaries the data of gut contents for damselfly nymphs (Zygoptera) and Table 2 fo rdragonfly nymphs

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TABLE 1. Percentage composition major dietary components in the gut of damselfly nymphs (Zygoptera) and in environmental water.

Seasons	Rotifera %		Cladocera %		Copepoda %		Rhizopoda %		Other aquatic Insect.		Algae %		Muscular tissue	Other unident. mat. %
	Gut	Water	Gut	Water	Gut	Water	Gut	Water	Gut	Water	Gut	Water		
Summer	13.5	8.0	15.8	33.3	5.0	21.4	25.2	4.3	15.5	14.0	7.5	20.0	7.0	10.5
Monsoon	8.0	30.6	21.5	4.6	3.0	16.5	17.5	5.6	18.0	25.0	5.8	17.7	15.0	12.0
Winter	15.7	27.2	18.5	8.2	10.0	21.5	14.0	17.0	27.0	15.1	1.8	11.0	5.0	8.0
Spring	19.5	32.6	24.3	16.6	15.0	8.5	8.0	12.3	21.0	25.0	1.7	5.0	5.5	5.0

TABLE 2. Percentage composition of major dietary components in the gut of dragonfly nymphs (Anisoptera) and in environmental water.

Seasons	Rotifera %		Cladocera %		Copepoda %		Rhizopoda %		Other aquatic Insect		Algae %		Muscular tissue	Other unidentifid mat. %
	Gut	Water	Gut	Water	Gut	Water	Gut	Water	Gut	Water	Gut	Water		
Summer	20.0	8.0	24.0	33.3	10.0	20.4	1.5	4.3	8.5	14.0	12.0	20.0	10.5	13.5
Monsoon	15.0	30.6	19.0	4.6	13.0	16.5	2.6	5.6	10.4	25.0	5.7	17.7	21.0	13.0
Winter	18.7	27.2	27.8	8.2	10.2	21.5	4.5	17.0	15.0	15.1	1.8	11.0	12.0	10.0
Spring	25.0	32.4	35.5	16.8	5.0	8.5	5.2	12.3	12.0	25.0	7.8	5.0	3.5	6.0

(Anisoptera). The dominant species of sub-order Zygoptera were *Ischnura delicata* (Hagen) and *Rhodischnura* sp. and of sub-order Anisoptera were *Mesogomphus lineatus* (Selys), *Potamarcha* sp. and *Zyxomma* sp. The gut content analysis of these nymphs revealed that they are primarily carnivorous in habit, feeding on micro-crustacea (Cladocera and Copepoda). rotifers, Rhizopoda, aquatic insects and other animal tissues present in the pond. Only a small percentage of plant material could be detected in the gut. They are mainly algae belongn g to Chlorophyta, Bacillariophyta and Myxophyta.

The seasonal variations of the feeding habit show that both damselfly and dragonfly nymphs prefer to take rotifers, Cladocera, Copepoda, Rhizopoda and aquatic insects (mayfly nymphs, Chironomous larvae, mosquito larvae and pupae). Certain ingested materials of animal origin could not be identified due to semi-digestion of food items in the foregut. In damselfly nymphs the Rotifera, Cladocera, aquatic insects and Rhizopoda form the maximum percentage of food items. But in dragonfly nymphs rhizopods were recorded in very small quantity and other food items viz., rotifers, Cladocera, Copepoda, aquatic insects and other animal tissues were in maximum percentage in the foregut. Members of the algal community belonging to the Chlorophyta, Bacillariophyta and Myxophyta were also recorded in small percentage in different seasons of the year. The percentage composition of plankton in the environment and the gut contents of these nymphs are summarised in the Tables 1 and 2 for Zygoptera and Anisoptera respectively.

The food items of these nymphs were identified as follows:—

Rotifera: *Brachionus* sp., *Brachionus calciflorus; Keratella* sp.

Cladocera: *Daphnia carinata; Moina dubia; Simocephalus elizabephae; Mysis* sp., *Clydorus* sp., *Diaphanosoma* sp.

Copepoda: *Cyclops* sp., *Diaptomus* sp.

Rhizopoda: *Arcella* sp., *Centropyxis* sp.

Aquatic insects: Mayfly nymphs: chironomus larvae; mosquito larvae aud pupae.

Chlorophyta: *Scenedesmus* sp., *Pediastrum* sp., *Chlorella* sp., *Pandorina* sp., *Hydrodictyon* sp., *Oedogonium* sp.

Bacillariophyta: *Amphora* sp., *Navicula* sp., *Gomphonema* sp., *Fragillaria* sp., *Cymbella* sp.

Myxophyta: *Anabaena* sp.

DISCUSSION

The gut contents analysis of Odonata nymphs show that the animal diet comprises the maximum percentage of dietary components whereas non-animal diet forms insignificant percentage. This view was supported by BENKE (1972, 1976) while he had made estimations of dragon fly production and pray turnover in South Carolina. He had expressed his views regarding feeding habits of Odonata as "stomach analysis for dominant dragon flies did not reveal significant non-animal contributions, since Odonate nymphs generally attack only moving prey, ingestion of non-animal items is negligible and probably insignificant."

In the present analysis Rotifera, microcrustacea, Rhizopoda, aquatic insects and remains of other aquatic animals were recorded in the guts of these nymphs. A small percentage of algal community belonging to the Chlorophyta, Bacillariophyta and Myxophyta were also recorded in different seasons of the year. However, microcrustacea, rhizopods, Rotifera and aquatic insects predominate in

the gut contents. According to LAWTON (1970) in *Pyrrhosoma nymphula* micro-crustacea always comprised well over 50 per cent of prey consumed, but formed < 15 per cent of their diet by weight. In the guts of damselfly (Zygoptera) nymphs percentage composition of Rotifera, Cladocera, and Copepoda is found lower than environment. The percentage composition of rhizopods and aquatic insects was found more in gut than in environmental water except in monsoon. It was probably due to the scarcity of food in the habitat. Algae constituted a small percentage of the diet of these nymphs, although their concentration in environmental water was found to be higher than in the gut.

In the gut contents of dragonfly nymphs the percentage composition of Rotifera, Cladocera, Copepoda is high in comparison to the environmental waters except in monsoon for Rotifera and in summer for Cladocera and Copepoda. The dragonfly nymphs seem to have some preference for Cladocera as food than the damselfly nymphs. The damselfly nymphs have a preference for Rhizopoda as their food items.

The diet of these nymphs may vary from season to season depending on abundance of particular prey types, which was clear from Tables 1 & 2. Field observations (HASSAN, 1974) on the abundant prey of libellulid larvae (Anisoptera) in Ibadan, Nigeria indicated that the abundance of each type of prey fluctuated seasonally and also varied from pond to pond. The availability of food also affects the rate of larval development of Odonata. In a semi-natural enclosure, vegetation provided hiding places for pray (HASSAN, 1974). In such conditions these nymphs have very hard time to find their specific food prey. It has been demonstrated by HASSAN (1974) that this probably accounts for much longer larval duration (58 days) of *Palpopleura lucia lucia* (Anisoptera) in nature than in the laboratory (39.8 days). He concluded that the former figure is probably close to what happens in eutrophic waters. Therefore, due to unavailability of proper food during the active period of development or body growth retards the emergence of adults in such water bodies. Thus, it may be concluded that the nymphal Odonata populations are largely regulated in numbers by the supply of food available to them in their habitat.

The switchover to an algal diet by Odonata nymphs did not appear to be related to a decline in numbers of potential animal prey. Rather, it was probably a response to an increased availability of an alternative, apparently suitable food source which was only present in those seasons. WINTERBOURN (1971, 1974) suggested that there are transition from an algal to a carnivorous diet and from carnivorous to algal diet in the last instar larvae of Trichoptera and Plecoptera respectively. However, no other study was available in which a high proportion of Odonata nymphal population has been shown to switch over from predation to algal feeding.

However, HYNES (1972) suggested that food may never become the factor limiting kinds of insects present in an aquatic habitat, since within certain broad limitations, most species can use a variety of food materials for nutrition during the active period of body growth. This ability to use a range of materials probably encourages exploitation of the aquatic environment to full extent.

Acknowledgements: The author is grateful to Professor J. S. Datta Munshi, F. N. A., F.N. Sc., Head of the Post-Graduate Department of Zoology, Bhagalpur University for valuable suggestions, constant guidance and critically going through the manusript. The author is also much thankful to Dr. D. N. Rai, S R F. (ICAR) for helping me in identification of plankton. This work was carried out under the tenure of a Teacher Fellowship awarded to me under F I P, University Grants commission, New Delhi.

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Entomon, 1984, *Vol.* 9, *No.* 31, *pp.* 31 *to* 34

BIOETHOLOGY OF *METEORIDEA HUTSONI* (NIXON) (HYMENOPTERA: BRACONIDAE), A PARASITE OF *OPISINA ARENOSELLA* WALKER, THE BLACK HEADED CATERPILLAR PEST OF COCONUT

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(*Received 13 August 1983*)

Meteoridea hutsoni (Nixon), which is a recently recorded larval-pupal braconid parasite of *Opisina arenosella* Walk., has a distribution limited to certain areas of Malabr, in Kerala. Observations on certain aspects of the biology and behaviour of this parasite are given. Females live longer than males: with 50% honey, females lived for 12.4 days whereas mates lived for 9.3 days. In the field males outnumber females, their ratio being 4 : 3. Total duration of life stages from egg to adult varies from 17 to 23 days.

(*Key words: Meteoridea hutsoni*, parasite; *Opisina arenosella;* bioethology and developmental biology)

INTRODUCTION

Meteoridea hutsoni was first recorded by NIXON (1941) by the name *Benama hutsoni*, as a solitary endoparasite of *Sylepta derogata*. The species was first recorded from the pupae of *O. arenosella* by SUDHEENDRAKUMAR *et al.* (1979) The present paper deals with certain aspects of the biology and behaviour of this newly recorded parasite. It is for the first time that a species of the genus *Meteoridea* has been studied closely for gathering biological information.

MATERIAL AND METHODS

In order to maintain a regular culture of the pest *O. arenosella* and its parasite *M. hutsoni*, the larvae and pupae of the former were collected from the field and kept individually in rearing tubes of size 10×2.5 cm. The adult parasite emerged were provided with 50% diluted honey as food. Mating behaviour was studied by keeping newly emerged virgin females and males in mating chamber (200 mm diam. glass petri dish covered with muslin cloth, with a small drop of honey which served as food for the parasite) and observing the behaviour under Carl Zeiss stereo microscope. Observations were made both at day and night to find out whether diurnal or nocturnal rhythm exist. Regular dissection of the parasitised host larvae and pupae were made to collect and study the immature stages of the parasite. All experiments and observations were conducted under laboratory conditions, with temperature 28±2 and Relative humidity 57 ± 5.

OBSERVATIONS

1. Distribution and habitat

In the costal areas of Kerala *M. hutsoni* has a limited distribution, being confined to Calicut district and some isolated areas of Malappuram District. It is found to parasitise *Opisina* during its late larval stages, *viz.*, III, IV and V instars. The parasitised larva continues to live normally till it pupates. The adult

parasite emerges out from such pupae of the pest. In the laboratory the adult parasite feeds readily on dilute solutions of honey, sucrose, fructose etc.

2. Mating

Females and males of *M. hutsoni* did not exhibit any rhythm (diurnal or nocturnal) in its mating behaviour. When introduced into the mating chamber the virgin females and males do not respond from a distance. But when the male comes close to the female within a range of 1 cm the male stops further forward movement and starts to open the wings and flutter them in a half opened posture for several seconds. Both visual and pheromonal stimuli appear to be essential for the typical courtship behaviour, since with the dead and preserved females, the males did not exhibit their wing fluttering behaviour. However, the females immediately after the death can still elicit wing fluttering in males, even though no mounting resulted.

After an intense flutter the male moves to the female and extends its genitalia by curving his abdomen under his body. Now he mounts over her and extends his genitalia by curving his abdomen until full contact is made with the female genitalia He continues the vibration of the wing for 2-3 seconds and then stops and keeps his wing in half opened position till the end of mating. During mating the male usually keeps his antennae forwardly directed touching the counterpart of the female, which in turn vibrates slowly in an antero-posterior direction. *Meteoridea hutsoni* takes 35 to 45 seconds for mating, including a minimum of 30 seconds for sperm transfer. A single male can mate with several females though the female once mated does not mate again even after the continuous performance of courtship movement by the same male or by another one. It is also found that old females are as receptive as young ones, but the old males are rather inactive. Mated females held with the host (so that they will lay eggs) also do not mate again. So it is presumed that the female mates only once.

3. Oviposition

The preoviposition period of *M. hutsoni* extends from .5 to 2 days. The parasite prefers to lay eggs into the late instar larvae (III, IV and V) of *Opisina arenosella* and *Sylepta derogata*. It has been observed that when cut leaflets of coconut palm without any infestation were introduced into the oviposition chamber, the parasite becomes active, extends its ovipositor and starts searching for the host at the cut end of the leaflets. This indicates the possibility that certain spe ific substance present in the host plant can elicit ovipositional behaviour in *M. hutsoni*.

4. Parthenogenesis and sex-ratio

Parthenogenesis exhibited by *M. hutsoni* is arrhenotokous, thus mating is not essential for oviposition. Based on extensive field studies for one year (from 1981 September to 1982 September), throughout the pest infested costal areas of Kerala it has become evident that in nature males outnumber females, with a ratio of 4:3 (Table 1). This may be due to arrhenotokous parthenogenesis.

5. Longevity

Females were found to live longer than males. When fed (on 50% honey) the female longevity showed a mean of 12.4 days with the individual life span ranging from 7 to 17 days, whereas that of the male was 9.3 days within a range

TABLE 1. Percentage of parasitism and sex ratio *M. hutsoni*.

Locality (collection site)	No. of pest larvae collected	No. of collected larvae pupated	No. of pupae collected	Total host stage (pupae+ larvae pupated)	No. of males emerged	No. of females emerged	Sex ratio (♂ : ♀)	% of parasitism
Kappad and Thikkodi	826	382	428	810	48	36	4 : 3	10.4

of 7 to 14 days. When starved both male and female lived only for 4 to 5 days.

6. Development

The egg of *M. hutsoni* is somewhat oval in outline and measures 0.1 mm in length and 0.06 mm in breadth. The larva is typically hymenopteriform with a distinct head and 13 body segments. Final instar larva measures 3.5 to 5 mm in length. Even though only a single adult parasite emerges out from a host pupa, occasionally 2 larvae of the parasite were found in a pupae, of which one that is bigger in size alone develops into adult. Final instar larva spins a yellow coloured cocoon around it and pupates within it.

Pupae of *M. hutsoni* is exarate and has a definite head, thorax and abdomen. Pupal length varies from 4 to 5 mm with a maximum breadth of 1 mm at the thoracic region. The antennae and mouth parts are ventrally directed. Compound eyes are initially brown, but later assume black colouration. Soon after pupation fat bodies can be seen through the transparent body wall.

Emergence of the adult takes place through a small round opening made by the parasite itself at the anterior end of the host pupa. Total life cycle from egg to adult is completed within 17 to 23 days.

DISCUSSION

In *Bracon brevicornis* mating is accomplished within a short period of 3-13 seconds (REMADEVI *et al.*, 1980), when compared to 35-45 seconds needed for *M. hutsoni*. Courtship behaviour in the above species consists of a number of stereotyped behavioural patterns, including the vibration of antennae, wing elevation, fluttering, mounting etc. Unlike in the case of several species of Chalcidoidea which possess elaborate post-mounting courtship patterns (MATHEWS, 1975), in *M. hutsoni* mating takes place immediately after mounting.

M. hutsoni does not paralyse the host before oviposition. This is true of all internal parasites except for the larvae of the bark beetle attacked by *Coeloides dendroctoni* Cush, which become inactive and appear paralysed within two days after attack and are dead on the third day (DELEON, 1935).

Life cycle of great majority of braconids is completed in a relatively shorter period. This is particularly so in the case of external parasites, for their developmental stages are not correlated with those of the host. Thus the minimum period of life cycle from egg to adult was reported as 7 to 9 days for *Microbracan lefroi* and *B. brevicornis*, from India. Unlike the above cases, in *M.*

hutsoni being an internal parasite, the development is completed in 17 to 23 days.

Acknowledgements: We are grateful to Prof. K. J. Joseph, Head of the Department for the facilities provided. One of us (S M G) is thankful to the University of Calicut for awarding a Junior Research Fellowship.

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COPULATION AND OVIPOSITION BEHAVIOUR OF *NESIDIOCORIS CAESAR* (BALLARD) (HETEROPETRA : MIRIDAE)

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(Received 22 May 1983)

Nesidiocoris caesar (Ballard) mates throughout the year. Male bug gradually approaches the female partner and mounts her from lateral side. The male inserts his aedeagus into the female genital chamber and soon turns back to assume tail to tail position forming an obtuse angle (160°) on the right side (due to reduced right paramere of the male genitalia). Copulation lasts for a mean of 2.08 hours 3 to 10 days after copulation the male usually dies or it is preyed upon by the female just after copulation. For oviposition, the stylets are driven deep by the female into the plant tissue and valvulae cut the epidermis and parenchyma obliquely and deep. At this spot, an egg is deposited at an angle of 30 to 40° below the plant epidermis in the parenchymatous tissue. Egg laying site can be located either due to turning brown of the site after some time or after 2-3 days when shimmering silvery white filaments of the operculum protrude out.

(Key words: nesidiocoris caesar, Lagenaria vulgaris Ser., *Nicotiana tabacum* L., aedeagus, claspers, genital capsule, valvulae)

INTRODUCTION

Nesidiocornis ceasar (Ballard) (Heteroptera-Miridae) is found seriously infesting the *Lagenaria vulgaris* Ser. and *Nicotiana tabacum* L. plants in western Uttar Pradesh (India) for the first time (CHATTERJEE, 1982). It is available throughout the year on its host plants. No information is available on its copulation and oviposition behaviour.

MATERIAL AND METHODS

To study copulation and oviposition behaviour, wire gauze cages (10×6×6 m) were used. Only one host plant i.e., *L. vulgaris* was chosen.

RESULTS AND DISCUSSION

Survey of the literature on Miridae reveals that copulation and oviposition behaviour has so far been described only as part of life cycle in *Engytatus volucer* (ROBERTS, 1930), *Lygus rugulipennis* (SOUTHWOOD, 1956), *Carvalhoia arecae* (NAIR & DAS, 1962), *Nesidiocoris tenuis* (EL-DESSOUKI *et al.*, 1976). But so far no account is available on the copulation and oviposition behaviour of *N. caesar*.

N. caesar usually copulates under laboratory conditions within 2—5 days of its emergence from the last instar during day or night. The male takes active part in wooing the female to participate in mating. First the male approaches the female by her side and touches her abdomen with his antennae: this is repeated a number of times. In the first few attempts the female tries to move away but ultimately becomes nearly immobile to allow the male to mount her. The male immediately rides her from the lateral side of the body

and holds her with his forelegs. In the mean-time, the claspers of the male firmly hold the ovipositor of the female so that the erected aedeagus may be inserted into the female genital chamber. The male succeeds in inserting his swollen and spiny tipped intromittent organ into the female genital chamber with some difficulty. Now the male turns back to assume tail to tail position forming an obtuse angle (160°) on the right side. This angle is formed due to reduced right paramere which results in asymmetry of the male genitalia. During mating genitalia of both the sexes are closely approximated.

Copulation usually lasts from one to three hours with an average of 2.08 hours. The disengagement of the copulating pair is very abrupt. After the separation, the male walks a short distance and later inserts his proboscis, inflexing his abdomen, within his genital opening. This position is maintained for five to ten minutes. At the end of the above act, a large blob of yellow liquid is passed out. These activities appear to be necessary in the end of copulation for restoration of aedeagus within the genital chamber. The female is also seen to clean her genitalia with her hind legs. Then, she rests for about two hours prior to resuming feeding activities.

It has been observed that the female bug mates several times during her life span with other males. Usually, 3—10 days after copulation the male bug dies. During the period it remains sluggish and rarely feeds or the female sucks her male partner, after copulation showing cannibalism (CHATTERJEE, 1982). However, if the couple is disturbed, soon after the copulation starts, both may disengage, and may copulate again after a short period of twenty to thirty minutes.

Preoviposition period lasts for 2 to 6 days with an average of 3.5 days.

The female lays egg within the host plant viz., *L. vulgaris* and *N. tabacum.* After copulation and preoviposition the female probes by means of the tip of her rostrum and inserts the stylets here and there, to search out a suitable site for egg laying. The female inserts her eggs anywhere into the petiole and young stems of *L. vulgaris* (the only host plant used for this study). The stylets are driven deep into the plant tissue. Complete operation requires about three minutes. Keeping its stylets still inside the plant tissue, the female bends forward to bring her ovipositor right over the site of puncture. As soon as the stylets are withdrawn from the plant tissue, the denticles or teeth present at the tip and lateral edges of valvulae cut the parenchyma obliquely and deep, till the entire length of valvulae reaches inside the host tissue. Powerful genital muscles assist the valvulae in piercing the plant tissue. Thereafter a series of alternate distensions and contractions of the abdomen and a sort of pumping action culminates in deposition of an egg at an angle of 30 to 40° below plant epidermis in the parenchymatous tissue and immediately the ovipositor is withdrawn.

However, in case the ovipositor misses the site of punctures made by the stylets, further probing ensues and oviposition is delayed for a while till the stylets again find out a suitable site. The egg laying site is normally not traceable just after the act is completed. However, it can be located either due to turning brown of the site or

after 2—3 days when shimmering silvery filaments of the operculum of the egg protude out and can be located among the epidermal hair of the plant with the help of magnifying glass. Moreover, just prior to hatching, about a quarter of an egg also protrudes above the surface of the plant tissue. The oviposition continues throughout the year. The male lives for 3—10 days and the female, for 5—20 days.

Acknowledgements: I express my sincere thanks to Director, Commonwealth Institute of Entomology, London for identification of this bug. I am also thankful to Dr. G. D. Garg and Dr. S. C. Dhiman, Lecturer, P. G. Department of Zoology, M. S. College, Saharanpur for their co-operation.

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TAXONOMIC STUDIES ON INDIAN GEOMETRIDAE I. GENUS *CHLORISSA* STEPHENS (SUBFAMILY : GEOMETRINAE)

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Three species, namely, *albifasciata* sp. nov., *pretiosaria* (Staudinger) and *punctifimbria* (Warren) have been studied. Another species viz., *aquamarina* Hampson has been shifted from genus *Hemithea* Duponchel to *Chlorissa* Stephens. *Chlorissa albifasciata* sp. nov. has been described in detail but in the case of other species, the information on the genitalia is included. A key to the 5 Indian species under the genus has also been given.

INTRODUCTION

The authors have been engaged in studies on Geometridae of North-West India for the last 6 years. As many as 99 species under 43 genera and 3 subfamilies have been collected. These include 14 new species. Three of these species, including a new one belong to genus *Chlorissa* Stephens.

The genus *Chlorissa* Stephens is so far represented by 3 Indian species namely *discessa* (Walker), *pretiosaria* (Staudinger) and *punctifimbria* (Warren). We have studied the last mentioned 2 species along with a new species ie., *albifasciata*. The new species was also compared with the third Indian species ie., *discessa* (Walker) in the British Museum (Natural History), London by Dr. D. S. Fletcher of that Museum. In addition, *aquamarina* Hampson has been shifted from genus *Hemithea* Duponchel to *Chlorissa* Stephens. Detailed description of the new species, descriptions of the male and female genitalia of *pretiosaria* (Staudinger) and *punctifimbria* (Warren) and a key to the Indian species are being reported in this communication. The characters of the genus *Chlorissa* Stephens have also been elaborated by including the structure of male and female genitalia.

Genus **Chlorissa** Stephens

Chlorissa Stephens, 1831, III. Haust., **3:** 315; Westw., 1840, Synops. Gen. Brit. Ins. 100; Dup., 1843, Dict. Univ. Hist. Nat., **3:** 607; Humphreys & Westw., 1845, Brit. Moths, **2:** 78; Prout, 1912, Gen. Ins., **129:** 172; 1913, Seitz Macrolep., **4:** 24; 1933. Seitz Macrolep. **12:** 116.

Nemoria Hubner, 1826, Verz. Bek. Schmett: 285 (part) (nec. Sect. typ.); Sederer, 1853, Verh. Zool.—Bot. Ver. Wien, **3:** 172. For complete list of reference see Lepidopterous Catalogus No. 14 (Prout, 1913)

Phaiogramma Gmpbg., 1887, Nova Acta. Acad. Leop., **49:** 326: 1896, **65:** 277.

Frons smooth. Antenna ciliated in male, cilia minute in female. Labial palpus moderate to long; second segment shortly rough scaled; third segment usually small in male. moderate to long in female. Proboscis present. Hind tibia

slightly dilated, with a hair pencil and short terminal spurs in male, median spurs wanting, female with all spurs. Abdomen without or with two small dorsal crests. Forewing with costal margin gently arched; apex moderate; termen smooth, nearly straight. Discal cell rather short; discocellulars incurved. R_1 usually from cell; free or sometimes anastomosing with Sc; R_2, R_3, R_4 and R_5 stalked; R_2 arising before R_5; M_1 from upper angle or shortly stalked with R_2—R_5, exceptionally just separate. Frenulum slender in male, wanting in female. Hind wing with termen weakly allowed at M_3 or rounded, never tailed. Discal cell short; discocellulars somewhat incurved. $Sc + R_1$ anastomosing with cell at a point near base; Rs and M_1 stalked; M_3 and Cu_1 stalked from lower angle of cell. Male genitalia with uncus pointed; socii slender and symmetrical, except *albifasciata* sp. nov.; gnathos weakly developed; harpe present; aedeagus pestillate; vesica with a large striated cornutus.

Type—species: *Chlorissa viridata* (Linnaeus).

Chlorissa pretiosaria (Staudinger) (Figs. 4, 5, 6, 14)

Nemoria pretiosaria Staudinger, 1877, Stett. Ent. Zeit., **38:** 202; 1892, Iris, **5:** 143; 1901, Cat. Lep. Palaearct., **1:** 264 *(Nemoria)*. Prout, 1912, Gen. Ins., **129:** 174; 1912 Seitz Macrolep., **4:** t. 2c; 1913: 25, 1933, Seitz Macrolep., **12:** 116.

Nemoria gelida Butler, 1889, Ill. Het. Brit. Mus., **7:** 21, 104, t. 136, f, 5; Hampson, 1895, Faun. Ind. Moths, **3:** 502 *(Nemoria)*; Wileman, 1911, Trans. Ent. Soc. Lond. : 340 *(Nemoria)*.

The following information is being added: Male genitalia with uncus slender, sharply acuminate distally, well sclerotized and sparsely setosed; socii slightly shorter than uncus, tapering uniformly distally, each fringed with short setae; gnathos weakly defined, V—shaped; tegumen longer than uncus, with a V—like thickening; vinculum strap-like, produced anteriorly into short conical saccus. Valva with costa better sclerotized than remaining portion; sacculus weak; ampulla curved and sclerotized; harpe represented by a sclerotized, shoe-shaped scobinate structure; posterior end of valva densely setosed. Aedeagus pestillate, with one of its walls conspicuously sclerotized; vesica marked with sclerotized stripes, rows of dents and a curved toothed plate, representing the actual cornutus. Coremata developed. Female genitalia with corpus bursae narrow, more or less tubular and membranous; signum wanting; ductus bursae comparatively broad, rugose and semi-membranous anteriorly, moderately sclerotized posteriorly, colliculum prominent; ostium bursae well marked; anterior apophyses short, broadened at base; posterior apophyses long, more or less of uniform thickness throughout; ovipositor lobes furnished with short and long setae.

Specimens examined: INDIA: HIMACHAL PRADESH: Chambaghat, 130 20, July to August; Solan 30 20, June; Simla, 100 20, July; Kulu, 10, June. Coll. V. K. Walia (Deposited in Entomology Section, Department of Zoology, Panjab University, Chandigarh).

Distribution: North-West India.

Chlorissa aquamarina (Hampson) Comb. nov. (Figs. 7, 8, 9, 15)

Hemithea aquamarina Hampson, 1895, Faun. Ind., Moths, **3:** 491; Prout,

1912; Gen. Ins., **129:** 171 *(Hemithea)*: 1933, Seitz Macrolep., **12:** 116, t. 13k *(Hemithea)*

? *Omphax marina* Butler, 1889, Ill. Het. Brit. Mus., **7:** 21 (nec Butler, 1878).

The following information is being added:

Male genitalia with uncus long, sclerotized, pointed distally and beset with a few setae; socii shorter than uncus, slender and semi-membranous; gnathos U—like, weakly developed: tegumen conspicuous, strengthened by a V—shaped sclerotized stripe; vinculum continued anteriorly into a prominent saccus, the latter produced distally into a comparatively weaker projection. Valva with extreme dorso-proximal part of costa overlapped by a thumb-like ampula; costa also supported by a thin sclerotized line; sacculus weakly differentiated, with remaining part of valva narrow and membranous. Aedeagus pestillate: vesica furnished with strongly sclerotized lines and patches. Coremata present. Female genitalia with corpus bursae dumble-shaped, semi-sclerotized, its distal end possessing vertical lines of sclerotization; signum absent: ductus bursae highly reduced, short and broad: genital plate ill-defined: posterior apophyses more than double the length of anterior apophyses: ovipositor lobes moderately long, bearing numerous short and long setae.

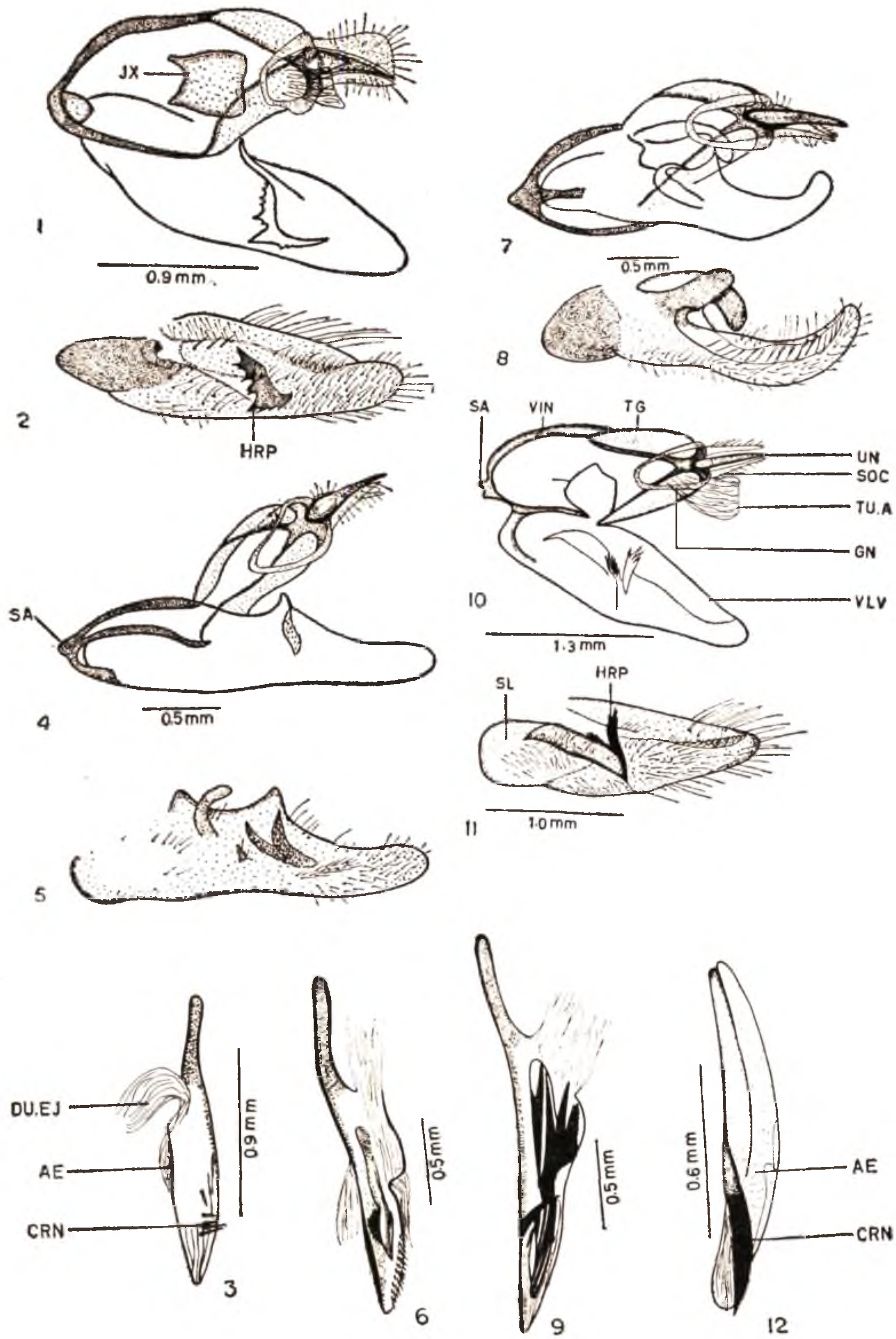
Specimens examined: INDIA: HIMACHAL PRADESH: Chambaghat, 4 ♂♂ 5 ♀♀, July to September: Solan, 2 ♂♂ 2 ♀♀, September. Light. Coll. V. K. Walia (Deposited in the Entomology Section, Department of Zoology, Panjab University, Chandigarh).

Distribution: North India.

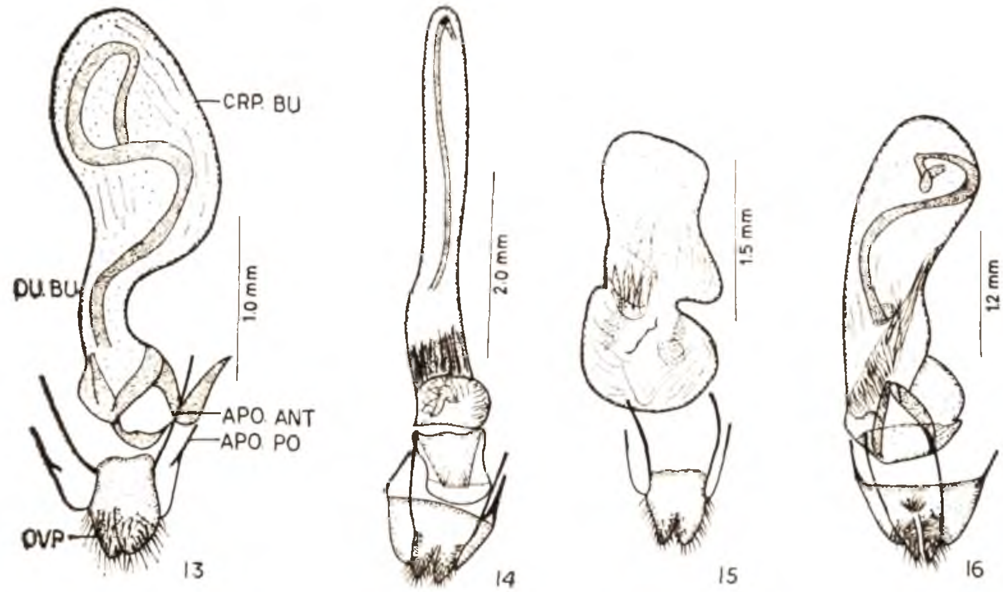
This species was originally described under genus *Hemithea* Duponchel by Hampson (1895). However, the ciliated antennae do not support its location under genus *Hemithea* Duponchel in which the antennae are dentate fasciculate. Accordingly, the species has been shifted to the genus *Chlorissa* Stephens and is found to be congeneric with other species under this genus. In fact, this status of the species has also been accepted for the collection located in B. M. N. H., London although. no report to that effect has so far been published.

Chlorissa punctifimbria (Warren) (Figs. 10, 11, 12, 16)

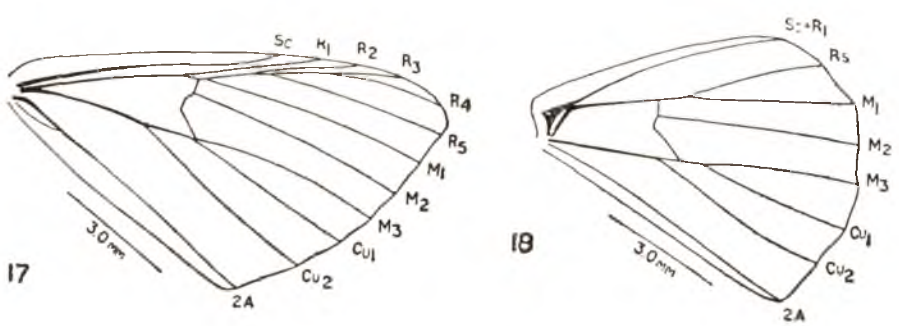
Hemithea punctifimbria Warren, 1896, Nov. Zool., **3:** 366; Prout, 1912, Gen. Ins., **129:** 174; 1933, Seitz Macrolop., **12:** 116, t. 13l. The following information is being added: Male genitalia with uncus more or less slender, pointed distally, fringed with weak setae: socii as long as uncus: gnathos weakly developed; tegumen longer than uncus, moderately sclerotized, with a V—shaped thickening: vinculum band-like, leading into a short saccus proximally. Valva with costa moderately inflated, less sclerotized than sacculus, supported by a sclerotized ridge proximally, the latter bearing a few setae; inner surface of sacculus produced into 8 or 9 spines: harpe clearly differentiated, strongly sclerotized its distal end furnished with 12-14 spines. Aedeagus pestillate: vesica armed with irregularly arranged dents and a sclerotized patch. Coremata developed. Female genitalia with corpus bursae somewhat twisted, bent towards one side, membranous: signum absent: ductus bursae short and broad, weakly sclerotized, with lines of sclerotization: genital plate constituted by narrow and bent arm like-structures joined anteriorly: anterior apophyses shorter than posterior apophyses, the former thickened at base: ovipositor



Figs. 1—12. Male genitalia of: Figs. 1, 2, 3. *Chlorissa albifasciata* sp. nov.; Figs 4, 5, 6 *Ch. pretiosaria* (Staudinger); 7, 8, 9. *Ch. aquamarina* (Hampson) Comb. nov.; Figs. 10, 11, 12. *Ch. punctifimbria* (Warren).



Figs. 13—16. Female genitalia of: Fig. 13. *Chlorissa albifasciata,* sp. nov.; Fig. 14. *Ch. pretiosarina* (Staudinger); Fig. 15. *Ch. aquamarina* (Hampson) Comb. nov.; Fig. 16. *Ch. punctifimbria* (Warren);



Figs. 17, 18 Fore and hind wings of *Ch. albifasciata,* sp. nov.

Abbreviations used in figures: 2A, Second anal vein; AE, Aedeagus; APO. ANT, Anterior apophyses; APO. PO, Posterior apophyses; CRN, Cornutus/cornuti; CRP. BU, corpus bursae; Cu_1, First cubitus; Cu_2, Second cubitus; DU. BU, Ductus bursae; GN, Gnathos; HRP, Harpe; JX, Juxta, M_1, First medius; M_2, Second medius; M_3, Third medius; OVP. Ova positor; R_1, First radial vein; R_2, Second radial vein; R_3, Third radial vein; R_4, Fourth radial vein, R_5, Fifth radial vein; Rs, Radial sector; SA, Saccus; Sc, Subcosta; $Sc + R_1$, Stalk of Sc and R_1; SL, Sacculus; SOC, Socii; TG, Tegumen; TRA, transtilla; TU.A, Tubi-analis; UN, Uncus VIN, Vinculum; VLV, Valva.

Photo 19. *Chlorissa albissa albifasciata*, sp. nov.

lobes broad proximally, narrowing gradually distally, beset with numerous setae of varying sizes.

Specimens examined: INDIA: CHANDIGARH, 3 ♂♂ 5 ♀♀, April to July, light Coll. V. K. Walia. Larvae feed on flowers of *Caeissa spinarum*. (Deposited in the Entomology Section, Department of Zoology, Panjab University, Chandigarh).

Distribution: India: Bombay, Chandigarh.

Chlorissa albifasciata, sp. nov. (Figs. 1, 2, 3, 13, 17, 18, 19).

Male: Head with vertex white: frons smoothly covered with dull light brown scales. Antenna two-thirds of fore wing length, miutely ciliated: scape and flagellum white scaled, the latter irrorated with green distally. Eyes black, bounded posteriorly with short white scales, labial palpus long, reaching beyond frons; second segment beset with green scales dorsally and half laterally, the remaining surface white: third segment short, green. Head studded with moderately long dull green scales behind.

Thorax smoothly clothed with grass green scales dorsally, white ventrally. Forewing with ground colour grass green, thickly marked with white striae; costa unmarked: a broad medial band with its inner edge strongly sinuous, outer edge finely dentate; inconspicuous marginal series of specks white; marginal fringe dull green. Underside white, without any marking. Discal cell two-thirds of wing length: DC_1 vertical: DC_2 incurved. R_1 free, arising from cell: R_2, R_3, R_4, R_5 stalked, M_1, also shortly stalked with them; M_3 and Cu_1 from lower angle of cell. Hind wing with termen smoothly curved. Ground colour grass green, with numerous white striae, an elongated dark green discocellular mark: a sinuous postmedial line white along its outer edge, strongly bent outwards between M_3 and 2A; and inconspicuous series of white marginal specks. Underside white, unmarked, Discal cell two-fifth of wing length; DC_2 oblique. Rs and M_1 stalked from upper angle of cell: M_3 and Cu_1 comparatively short

stalked from longer angle of cell. Legs pale white.

Abdomen smoothly covered with grass green scales on upper side, without tufts; ventral surface white. Male genitalia with uncus heavily sclerotized, sharply pointed distally, beset with short setae; socii as long as uncus, asymmetrical: gnathos more or less rectangular, weakly defined: tegumen supported by V—shaped sclerotized bar: vinculum longer than tegumen; saccus short, valva with costa narrowly inflated, moderately sclerotized and supported by a sclerotized line; sacculus better sclerotized than costa: harpe plate-like, with one of its edges produced into dents of various sizes: ampulla knobbed, bearing 3 prominent spines: distal end of valva rounded: beset with setae of variable sizes. Aedeagus pestillate: vesica marked with sclerotized lines and 5 conspicuous spines of unequal size in posterior half. Coremata present. Female genitalia with corpus bursae large, more or less oval in shape, semi-membranous: ductus bursae curved and weakly sclerotized, with a distinct colliculum: genital plate ring-like, enclosing ostium bursae; anterior apophyses one-half of posterior apophyses: ovipositor lobes densely setosed.

Wing expanse (Half : Male, 11 mm—13 mm; Female, 12 mm –14 mm.)

Holotype: ♂, INDIA : CHANDIGARH Panjab University Hostel. 7.iv.1980, light Coll. V. K. Walia. **Allotype** ♀, same data as for holotype.

Paratypes: 6♂♂ 2♀♀, same place as for holotype, April to July. Coll. V. K. Walia and H. R. Pajni (Types in Entomology Section, Department of Zoology, Panjab University, Chandigarh.

Distribution : India : Chandigarh.

This species has general resemblance with other congeneric species. However, the termen of the hind wing is smoothly curved as compared to more or less weakly angled or bent termen in others. This provides an easy identificational mark for the new species. Moreover, the two socii in this case are distinctly unequal whereas the socii in the other four species are more or less similar (Prout, 1912).

KEY TO THE SPECIES OF CHLORISSA STEPHENS

1. Hind wing with termen angled at vein M_3 2
   —Hind wing with termen rounded.......... 4
2. Both wings with postmedial line straight: frons chestnut; male genitalia with harpe represented by a shoe shaped scobinate structure.............*pretiosaria* (Staudinger)
   —Both wings with postmedial line sinuous or with a series of specks, frons green; harpe not so, if present................. 3
3. Wings bluish-green, each with a series of marginal white specks; valva without harpe....*aquamarina* (Hampson) Comb. nov.
   —Wings dull green, each with a series of greyish-fuscous marginal spots; harpe strongly developed, with its distal end furnished with 12–14 spines............ ....*punctifimbria* (Warren)
4. Frons light dull brown; labial palpi green; wings grass green.................. ....*albifasciata*, sp. nov.
   —Frons and labial palpi red; wings yellowish-green..................*discessa* (Walker)

Acknowledgements: The authors are grateful to the University Grants Commission, for financing a 3-year project on the North-West Indian Geometridae. Thanks are due to Dr. D. S. Fletcher, British Museum (Natural History), London, for the comparison of collection and to the Chairman, Department of Zoology, Panjab University, Chandigarh for providing necessary research facilities.

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WEED-CROP INTERACTION WITH REFERENCE TO *CALIOTHRIPS INDICUS* (BAGNALL) (THYSANOPTERA: THRIPIDAE) ON *ARACHIS HYPOGAEA* WILLD. (FABACEAE) AND AN ALTERNATE WEED HOST *ACHYRANTHES ASPERA* LINN. (AMARANTACEAE)

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(Received 13 November 1982)

Diversity of fecundity rates as well as duration of post-embryonic development have been observed in *Caliothrips indicus*, a polyphagous pest species, infesting *Arachis hypogaea* and the weed *Achyranthes aspera*. Rainfed *A. hypogaea* in the age group of 15-30 days appears to be highly susceptible to infestation of *C. indicus*. Spatial and seasonal distribution of this thrips spacies are significant on *A. aspera*. Both weed density and predatory role of *Geocoris ochropterus* Fieb. are important biotic factors for the population fluctuation of *C. indicus*

(Key words: weed-crop interaction, *Caliothrips indicus, Arachis hypogaea, Achyranthes aspera*, predation, *Geocoris ochropterus)*

INTRODUCTION

The genus *Caliothrips* is well represented by 28 species from different regions of the world (FAURE, 1962) several of them being economically important, species such as *C. impurus* (Priesner) *C. sudanensis* (Bagnall and Cameron), *C. phaseola* (Hood), *C. fasciatus* (Pergande) and *C. indicus* (Bagnall) are recognized as pest species of different crops viz., cotton, bean, groundnut, pea, cotrus, sorghum, onion, etc., in various parts of the world (RAMAKRISHNA AYYAR, 1932; BAGNALL & CAMERON, 1932; ANANTHAKRISHNAN, 1971). Of the five species of *Caliothrips* so far recognized in India (ANANTHAKRISHNAN, 1969; ANANTHAKRISHNAN & SEN, 1980; BHATTI, 1972), only *C. indicus* is reported as a polyphagous pest of various crops like pea (VAISHAMPAYAN *et al.*, 1963), groundnut (RAMAKRISHNA AYYAR, 1932; ANANTHAKRISHNAN 1971, 1973; RAI, 1976), soybean (WILSON, 1975) and onion (SAXENA, (1971), the biology of this species being known from the latter host. Several alternate weed hosts are known for *C. indicus* (ANANTHAKRISHNAN, 1971) among which *Achyranthes aspera* Linn., a major host occurs on groundnut (*Arachis hypogaea*) fields and harbour the pest almost throughout the year (ANANTHAKRISHNAN *et al.*, 1982). Studies on different species of thrips on the crop as well as on their alternate weed hosts established that the pest population on the crop is inversely proportional to that on the weed (ANANTHAKRISHNAN & THANGAVELU, 1976; TAYLOR, 1974; ANANTHAKRISHNAN & THIRUMALAI, 1977). An attempt has been made to understand the biology, population trends, degree and season of

infestation of *C. indicus* both on the crop plant *(Arachis hypogaea)* as well as on the alternate weed host *(Achyranthes aspera)*. The role of the weed density on *C. indicus* population in the fields was also investigated.

MATERIAL AND METHODS

Three types of cultures were maintained to study various aspects of the biology of *C. indicus:* (i) pot-culture to assess the parthenogenetic and sexual modes of reproduction; (ii) small separate glass vial (4.5 × 3.3 cm) culture to rear the adults *en masse;* and (iii) single gravid female was reared in separate glass vial provided with fresh leaf every day. The number of eggs inserted into leaves was counted by using the technique of GADDOURA *et al.* (1967). Live *C. indicus* collected locally was used for the biological studies in all the culture methods. Ecological studies pertaining to the density of the weed and the population studies (using dry count technique of the Delayed Counting Method of IRWIN *et al.*, 1979) on both the hosts were made by regular surveys in the fields in and around Tindivanam (South Arcot District, Tamil Nadu). The impact of damage on histological basis caused by *C. indicus* was assessed by examining sections of infested leaves.

RESULTS

Types of reproduction and post-embryonic development

Though normally sexual reproduction is more pronounced, arrehenotokous parthenogenesis is not uncommon. In sexual reproduction the sex ratio is 3:2 (female: male), while parthenogenesis alters it because of the production of only males. Gravid females prefer the second recognisable node for laying bean shaped eggs very close to the veins. Under laboratory conditions the eggs are laid close to each other. In the sexual reproduction fecundity is 130±5 and 70±5 whereas in parthenogenesis it is 120 ± 5 and 55±5 on *A. hypogaea* and *A. aspera* respectively. Prolonged life cycle (18—26 days) and high fecundity (120—130) is observed in the crop *A. hypogaea* while reverse is the case (16—21 days and 55—70 eggs) in the weed *A. aspera.*

Season and pattern of infestation

C. indicus occurred on *Achyranthes aspera* almost throughout the year except in July, although its infestation on *Arachis hypogaea* was seasonal. In Tamil Nadu, *A. hypogaea* is grown twice a year as irrigated and rainfed crop and the infestation of thrips is evident on 15-30 day old seedling of the rainfed crop. On the weed *A. aspera* the gravid females always preferred the second nodal leaves for oviposition. During initial infestation, the adults and larvae were seen on the upper and lower surfaces on the leaves respectively, very close to the veins but later they spread all over the

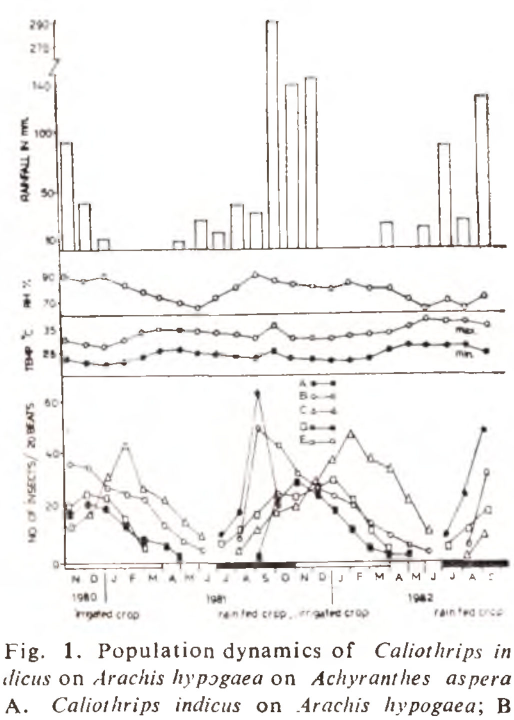

Fig. 1. Population dynamics of *Caliothrips indicus* on *Arachis hypogaea* on *Achyranthes aspera.* A. *Caliothrips indicus* on *Arachis hypogaea*; B. *Caliothrips indicus* on *Achyranthes aspera*; C. Weed density; D. *Geocoris ochropterus* on *Achyranthes aspera*; E. *Geocoris ochropterus* on *Arachis hypogaea.*

leaf. With the spreading of the adults, the infestation of the larvae also spread over the upper surface. Histological studies of both *A. hypogaea* and *A. aspera* infested with *C. indicus* revealed that the adults always consumed the cell contents of the palisade parenchyma leading to the appearance of silvery white patches on the adaxial side of the leaf, but larvae were found to feed on the spongy parenchyma.

Population trends

Achyranthes aspera, an annual weed, appears by August in *Arachis hypogaea* fields and acts as a reservoir host for the thrips pest. The density of this weed declines from March to June, resulting in the increase of thrips on each plant. The life cycle of this annual weed ends in June and eventually leading to the disapperance of thrips population. With the onset of fresh crops of *A. hypogaea*, *C. indicus* migrates from *A aspera*. With a high fecundity rate, *C. indicus* population quickly builds up on the crop. The peak population of the pest, both on the crop as well as on the weed is evident during September and the heavy rainfall during the following months (October-December) plays a significant role in brining down the population of *C. iudicus*. When the weed density increases by September there is migration of *C. indicus* from the crop to the weed. During the season of irrigated crop, though young seedlings of *A. hypogaea* are available, no migration from the weed to the crop was noticed and this period is marked by a maximum density of the weed *A. aspera* in the fields.

Thrips-predator interaction

Geocoris ochropterus Fieb. (Lygaeidae : Heteroptera) consumed many larvae and adults of *C indicus* acting as an effective predator, both on *A. hypogaea* and on *A. aspera* under laboratory condition as well as in the field, it preferred larvae to adults. *G. ochropterus* appeared on *A. aspera* in September, after the appearance of *C. indicus* on the weed, and increased gradually in number. The life-cycle of the prey is shorter (18.5 days) than that of the predator (35.5 days), so the population of the prey increased very quickly. By April the population of both *C. indicus* and *G. ochropterus* reaches the peak. Thereafter *C. indicus* population declines apparently due to the heavy feeding efficiency of *G. ochrapterus*. Following the decline of the prey population a steep fall in *G. ochropterus* population is also noticed. *G. ochropterus* occurs on the crop *A. hypogaea*, throughout the growing season and its interaction with *C. indicus* was noticed only during August to October.

DISCUSSION

Population studies of *C. indicus* reveal the existence of a sustained, but low thrips population throughout the year on the weed host (*A. aspera*). The occurrence of this weed almost throughout the year could be considered as a factor responsible for the occurrence of the thrips. In contrast, the thrips population on *A. hypogaea* depends on the seasonal occurrence of the crop plant, and the population peak of these insects is comparatively higher than on the weed. Similar population trends have also been observed in *Taeniothrips sjostedti* (Trybom) in cowpea and its alternative weed host *Centrosoma pubercius* (TAYLOR, 1974). In thrips like *Chirothrips mexicanus* Crawford (ANANTHKRISHNAN & THIRUMALAI, 1977) and *Haplothrips ganglbaueri* Schmutz (ANANTHAKRISHNAN & THANGAVELU, 1976) that infest graminaceous

weeds and crops, the population density is more on the weed than on cultivated crops.

Continuous availability of *A. aspera* almost throughout the year is an important factor for *C. indicus* maintenance in the case of *Stenchaetothrips* (= *Baliothrips biformis* (Bagnall) (ANANTHAKRISHNAN & KANDASWAMY, 1977). *C. indicus* exhibits faster develoment with short duration of life-cycle to that of the predator. Though highly seasonal, a quick population build-up occurs in *A. hypogaea* due to very high fecundity of *C. indicus*, in spite of the longer developmental period. Unlike *T. sjostedii*, that breeds only on the crop (TAYLOR, 1974), *C. indicus* breeds both on the crop and on the weed host. In view of its short life-cycle as well as the availability of food and breeding grounds, *A. aspera* could be considered as the primary host. The decline in the weed density results in higher population density of *C. indicus* per plant. The complete disappearance of *A. aspera* for a short period synchronises with the development of rainfed crop plants to which the thrips ultimately migrate from weed hosts. After the rains, even when there is a subsequnt increase of weed plants, thrips infestation remains very low. The removel of crop plants forces the thrips to migrate back to the weeds. During the irrigated season the weed density was high and infested with good number of thrips and no *C. indicus* was observed on the crop though the young seedlings are available in the field.

Acknowledgements: The authors are grateful to Prof. T. N. ANANTHAKRISHNAN, Director of Entomology Research Institute and Principal Investigator of the ICAR Project, under whose guidance this work was carried out. This work was done during the tenure of the ICAR grant for which thanks are due.

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SOME NEW AND UNKNOWN APHIDS (HOMOPTERA: APHIDIDAE) FROM MANIPUR, NORTHEAST INDIA

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(*Received 28 February 1983*)

This paper reports four aphid species under four genera. Two of these species are new to science. Two other species are new records for India and for 1 of these hitherto unknown oviparous female has also been found.

(*Key words:* aphids, new species, new records)

INTRODUCTION

The collection of aphids from Manipur, so far examined has revealed 2 new species, viz. *Capitophorus litanensis* and *Eumyzus nokuli* and 2 other species, viz, *Coloradoa artemisicola* Takahashi and *Tuberculatus konaracola* (Shinji) as new records from India. Moreover, for the last named species the hitherto unknown oviparous female has been found. Descriptions of new species and the hitherto unknown oviparous female have been provided.

The material of the species dealt with here are presently in the collection of the Entomology Laboratory, Department of Zoology, Calcutta University.

1. **Capitophorus litanensis** sp. nov.

Apterous viviparous female: Body about 1.47—1.48 mm long with about 0.76 mm as its maximum width. Head with well developed lateral frontal tubercles; dorsal cephalic hairs on raised sockets, long, stout, with capitate apices, about 1.80—2.20 × b. d. III. Antennae 6-segmented: about 1.20—1.30 × body; segment I shorter than its basal width and with I sho.t hair having capitate apex on inner margin near apex: flagellum gradually distinctly imbricated apicad: p. t. about 8.80—8.90 × base of antennal segment VI; flagellar hairs very small with capitate apices, longest one on segment III being about 0.20—0.30 × b. d. III. Rostrum reaching hindcoxae; u. r. s. long, about 1.95—2.10 × h. t. 2 and bearing 2 secondary hairs. Abdominal dorsum (Fig. I) pale and smooth; each of anterior abdominal tergites with 6 capitate hairs, arranged spinally, pleuraly and marginally of these spinals and marginals being about 3.0 × and pleurals about 0.25 × b. d. III, post siphuncular segments with spinal hairs duplicated, each of 7th and 8th tergites with 4 such hairs, these being 3.0—3.30 × b. d. III. Siphunculi cylindrical, imbricated, flanged and with 2—3 rows of interconnecting striae near apex, about 3.0 × elongated cauda having blunt apex and bearing 8—9 hairs. Legs pale: femora smooth excepting imbricated apex: outer hairs on leg with capitate apices,

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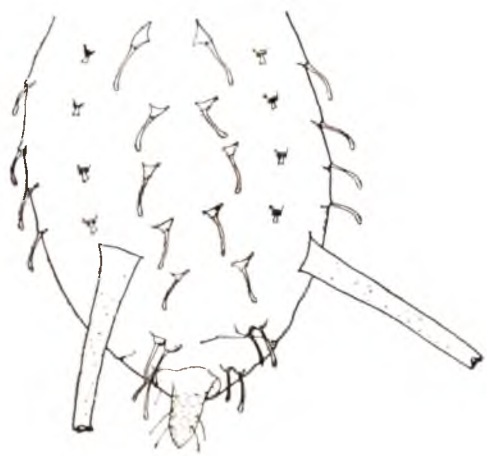

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Fig. 1. *Capitophorus litanesis* sp. nov.: Aptera : showing abdominal dorsum.

the inner ones being with blunt to slightly acuminate apices.

Measurements of the holotype in mm: Length of body 1.55; width 0.83; antenna 1.97, segments III: IV: V: VI 0.41 : 0.31 : 0.27 : (0.08 + 0.73); u. r. s. 0.13; h. t. 2 0.07; siphunculus 0.48; cauda 0.16.

Holotype: 1 apterous viviparous ♀, India, Manipur, Litan, from *Bidens* sp. (Compositae), on 7.xii.1971, coll. T. K. Singh; **Paratypes:** 3 apterous viviparous ♀♀ and 3 nymphs, collection data otherwise same as for the holotype.

Remark: Present species in having spinal hairs duplicated may be related to *Capitophorus cirssiphaga* Takahashi, *C. eleagni* Koch and *C. carduinus* Walker though truly in the latter two species, "the setal bases are closely placed" (Corpuz-Raros and Cook, 1974: Hille Ris Lambers, 1947). But the new species stands distinct from (a) *C. cirssiphaga* in having i) 4 hairs on 8th tergite, ii) 1 hair on ant. seg. I, and iii) much long spinal hairs (3.0—3.30 × b. d. III); from (b) *C. eleagni*, in having i) 1 hair on ant. seg. I, ii) too short pleural hairs (0.11 × spinals) and iii) too long spinal hairs: and from (c) *C. carduinus* in having i) ant. seg. I with 1 hair, ii) ant. seg. III with capitate hairs and iii) abdominal dorsum with spinal hairs of similar lengths.

Again, following the key provided by Basu and Raychaudhuri (1976) for the genus *Capitophorus*, this species comes close to *C. indicus* and *C. hippophaes* group in having single spinal hairs atleast on the antesiphuncular segments but can very well be differentiated by the presence of duplicated spinal hairs on postsiphuncular segments.

2. Coloradoa artemisicola Takahashi

Specimen examined: 1 apterous viviparous ♀ from *Adhatoda vasica* (Acanthaceae) India, Manipur, Kulbung, 2.ii.1971.

3. Eumyzus nokuli sp. nov.

Apterous viviparous female: Body about 1.41—1.53 mm long with 0.91—1.01 mm as maximum width. Head (Fig. 2) faintly brown, rugose dorsally, with a few warts at the bases of antenna sockets and lateral frontal tubercles, with some pustules medially on venter; median frontal prominence absent; long, rigid, dorsal cephalic hairs on tuberculate bases and with acuminate to slightly

2

Fig. 2. *Eumyzus nokuli* sp. nov. : Aptera : showing cephalic dorsum.

furcated apices. Antennae nearly concolourous with head, 6-segmented, about 0.41—0.48 × body: segment I scabrous dorsally, shorter than its width, with about 4 hairs; flagellum imbricated; hairs on flagellum short with acuminate to bluntish apices, longest hair on segment III being about 0.30—0.50 × b. d III; p. t. about 2.40—2.60 × base of antennal segment VI. Rostrum reaching midcoxae; u. r. s. about 1.30—1.50 × h. t. 2 with about 4-6 secondary hairs. Midthoracic furca sessile. Abdominal dorsum (Fig. 3) with a pale brown central patch extending over almost all segments in addition to marginal patches; dorsal hairs numerous, rigid and on tubercles, with acuminate to furcated apices, longest one on anterior tergites being about 3.0—3.60 × b. d. III; 8th tergite with 4 hairs, longest one being about 3.80—4.20 × the mentioned diameter. Siphunculi basally pale and distally gradually darker, short, densely imbricated with a few striae just before flange, about 0.07—0.08 × body and about 1.28—1.50 × short, black cauda which is thumb shaped, nearly as long as wide and bear 3—5 hairs. Legs concolourous with head but tibiae and tarsi darker; femora and tibia smooth; F. T. C. 3, 3, 2.

Measurements of the **holotype** in mm: Length of body 1.48; width 0.97; antenna 0.63, segments III : IV : V : VI 0.16 ; 0.06: 0.06: (0.06 + 0.16); u. r. s. 0.08: h. t. 2 0.06; siphunculus 0.11: cauda 0.08.

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Fig. 3. *Eumyzus gokuli* sp. nov. : Aptera : showing posterior part of abdominal dorsum

Alate viviparous female: Body about 1.47—1.61 mm long with 0.73—0.76 mm its maximum width. Head brown, smooth on both surfaces, without lateral frontal tubercles; dorsal cephalic hairs shorter than in apterae and with acuminate apices. Antennae brown, about 0.84 × body; flagellar hairs short, longest hair on segment III about 0.50—0.60 × b. d. III; segment III with 20 rounded, protuberant secondary rhinaria distributed irregularly over entire length, segment IV with similar rhinaria and V with 0—1 such rhinaria; p. t. about 2.83 × base of segment VI. Rostrum passing beyond midcoxae. Abdominal dorsum pale with segmentally arranged brownish transverse bands on segments 2—7, these sometimes confluent on anterior tergites with marginal patches with also present laterally; dorsal hairs shorter than in apterae, longest one being 1.66 × b.d. III and shortest one being about 0.65 × the mentioned diameter. Siphunculi brown, femora and tibia pale brown basally and darker distally. Wing venation normal. Other characters as in apterae

Measurements of one alata in mm: Length of body 1.47; width 0.73; antenna 0.84, segments iii.iv.v.vi 0.22:0.11:0.09 : (0.08+0.24); u.r s. 0.09; h.t.2 0.06; siphunculus 0.11; cauda 0.08.

Holotype : apterous viviparous ♀ : INDIA : MANIPUR : Leicukhong, from *Senecio* sp. (Compositae), on 10.ix.1972, coll. T. K. Singh; **paratypes :** 8 apterous and 2 alate viviparous ♀♀, data same as for the holotype.

Remarks : Present species can best be related to Takahashi's (1965) species *Eumyzus clinopodii* in having evenly

sclerotised abdominal tergum (Miyazaki, 1971). Presence of furcates body hairs sufficiently justifies erection of new species. The species is named after Shri Th. Nokuleshwar Singh, late father of T K.S.

Distribution : India : Manipur.

4. Tuberculatus konaracola (Shinji)

Specimen examined: 3 alate vivparous ♀♀, 2 apterous oviparous ♀♀ and 4 nymphs from an unidentified plant (Myrtaceae), India, Manipur Raphei, 11.xii. 1972.

Apterous oviparous female : Body about 2.01—2.47mm long with 0.83 mm as maximum width. Head pale, with 3 pairs of long spatulate hairs on tubercles anteriorly and 2 pairs of such hairs posteriorly. Antennae brown, about 0.72—0.73 × body; segment III with 3-5 rounded secondary rhinaria distributed on basal 0.50—0.70 portion: longest hair on segment III about 1.80—2.0 × b.d.III; p. t. about 1.50 × base of segment VI. Rostrum reaching midcoxae: u.r.s. about 0.80 × h.t.2. Prothorax with 2 hairs anteriorly and 4 posteriorly, each of meso and metathorax with 2 pairs of spinal hairs besides 2 pairs of marginal ones. Dorsum of abdomen pale with 4 pale brown transverse bands medially on tergites 1-4, each of these with 2 pairs of spinal hairs on very low tuberbles; such hairs also present on tergites 5 and 6; each segment with marginal hair bearing tubercles, those anterior to siphunculi triplicated but posterior to it duplicated, 7th tergite with 4 spinal and 2 pleural hairs; hairs on 8th tergite not discernible. Hind tibiae swollen with many pseudosensoria.

Measurements of one ovipara in mm: Length of body 2.04: width 0.76; antenna 1.51, segments III: IV : V : VI 0.43 ; 0.24 : 0.24: (0.16+0.24): u r.s. 0.10; h. t. 2 0.72: siphunculus 0.11.

Distribution : India : Manipur; Japan and Korea.

Remarks: Hille Ris Lambers (1972) while discussing the genus *Tuberculatus* in detail provided a key to the species. Following the said key the material was found to be *T. konaraeola* (Shinji). Dr. F. W. Quednau while confirming the identity of the species pointed out that the Indian material has siphunculi more dark than the Korean material. The apterous oviparous female being hitherto unknown is described here.

Acknowledgements: The author are grateful to Dr. F. W. Quednau, Canada for kindly comenting on the identity of the last named species. One of the authors, D. Raychaudhuri expresses heartfelt thanks to the University Grants Commission for partly financing the project. Heartfelt thanks are extended to the Head of the department of Zoology, Calcutta University for providing laboratory facilities.

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BRIEF CGMMUNICADION

NEW RECORDS OF PARASITES ON *JANSEODES MELANOSPILA* (LEPIDOPTERA: NOCTUIDAE), A DEFOLIATOR OF *DOLICHOS* SP.

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(Received 17 October 1983)

Four parasites namely, *Tetrastichus ayyari*, *Brachymeria lasus*, *Pimpla* sp. and *Apechthis* sp. were recorded newly on *Janseodes* sp. and these parasites were found to control the latter effectively.

(Key words: Janseodes, parasites)

In November 1977, a severe defoliation of a field bean *(Dolichos lab lab)* crop was noticed at Habbal, Bangalore. There were no larvae visible on the foliage but closer examination of the dry leaves on the ground revealed the presence of several larval and pupal stages of the pest. These were reared to the adult stage and identified as *Janseodes melanospila* Guenee. The original description of this genus was given by VIETTE (1967). The insect has been described in Fauna of British India (HAMPSON, 1891) as *Caradrina melanosticta* Hampson. Other synonyms are, *Caradrina hugeli* Felder, *Pasira russa* Swinhoe and *Pasira aenigmatica* Swinhoe.

The species ranges through most of the African tropics and occurs in India and Sri Lanka. It has been recorded from several localities in the New World Tropics, possibly an introduction there (HOLLOWAY, Pers. Communication). Its occurrence on *Dolichos lab lab* is being reported for the first time.

As chemical control of pests on *Dolichos lab lab* is not economically feasible, observations on the extent of natural parasitisation of this pest was made.

Large number of larvae and pupae were collected from the field and reared individually in the laboratory until the emergence of parasites. No parasite emerged from the larval stage, whereas from the pupal stage, four hymenopterous parasites emerged. The extent of parasitisation during the three months under observation is given in Table I. The combined parasitism for the three months (from November 1977 to January 1978) increased from 42.0 to 93.0 per cent for the third month. Of the four parasites, *Tetrastichus ayyari* Rohwer was the most dominant recording a parasitisation of 34.0, 52.0 and 83.0 per cent respectively for the three months. The mortality caused by the other three parasites, viz. *Brachymeria lasus*. (Walker), *Pimpla* sp. and *Apechthis* sp. was 7.3, 3.0 and 1.3 per cent, respectively.

The extent of natural biological control was rated as good and was expressed in terms of infestation by the pest subsequently. The pest population was at a very law ebb during the second month (probably the second generation) and did not occur at all after the third

month. This reflects on the check offered by the natural enemies particularly *Tetrastichus ayyari*.

T. ayyari is a polyphagous parasite and its host range includes *Chilo zonellus* (Swinhoe), *Argyria sticticraspis* (Hampson) and *Diatraea venosata* (Wlk.) reared from the field (CHERIAN & SUBRAMANIAN, 1940) In the laboratory it has been reared on more than 20 hosts including *Corcyra cephalonica*, *Heliothis armigera*, *Crocidolomia binotalis*, *Adisura atkinsoni* etc. (PUTTARUDRAIAH & SIVASHANKARASASTRY, 1958).

A brief study of the biology of this parasite on *Janseodes melanospila* revealed the following obervations. The total developmental period from oviposition to adult emergence ranged from 14 to 17 days with an average of 15.4 days. Freshly formed pupae were preferred to older pupae for oviposition. The number of parasites emerging from a single host pupa ranged from 35 to 67 with the average being 56.

From this preliminary study it is clear that the pest is effectively controlled in the field by its natural enemies and does not require chemical control measures to suppress it.

Acknowledgements: The authors are grateful to Dr. J. D. HOLLOWAY, Commonwealth Institute of Entomology, for identifying *Janseodes melanospila* and also providing the available literature on it, and to Dr. Z. BOUCEK for identifying the eulophid and chalcidid parasitel and Mr. I. D. GAULD for determining the Ichneumonidae.

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BRIEF COMMUNICATION

SEASONAL OCCURRENCE OF GRAPEVINE FLEA BEETLE, *SCELODONTA STRIGICOLLIS* (MOTS) AROUND HYDERABAD

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(*Received 23 October 1983*)

Seasonal occurrence of the grapevine flea beetle, *Scelodonta strigicollis* around Hyderabad was studied.

(*Key words:* seasonal occurrence, grapevine flea beetle)

The flea beetle *Scelodonta strigicollis* (Mots.) is one of the destructive pests of grapevine in the country. The information on the seasohal prevalence of this pest is meagre and hence the study was taken up.

The study was conducted in grapevine gardens of Thimmapur, 40 km away from College of Agriculture, Rajendranagar, Hyderabad. Grapevines of variety *Anab-e-shahi* trailed on *Mandwa* system were selected. Fits of 25 × 25 cm were dug half a metre away from the main trunk below the main arm of each vine at depths of 0-5, 6-10, 11-15 and 16-20 cm and the grubs and pupae present were counted and recorded. The adult population was enumerated in half metre of the trunk just below from where it branches off, as the pest often found resting at that place. Data were recorded at weekly interval on 1st, 8th, 15th and 23rd of every month commencing 1st June, 1981 to 23rd April, 1982.

A perusal of data (Table) indicates that the incidence of grubs and pupae of flea beetle was noticed on 8th and 23rd June respectively and both the stages reached a peak level of population on 23rd July. Immediately, the population of both the stages started declining steadily upto 1st September and again raised to a second peak on 8th September and declined subsequently to nil on 8th October. The adult beetle was first noticed on 23rd July and the population gradually increased to peak level on 23rd September. and completely disappeared on 1st October. The pest again appeared on 8th October and completely disappeared on 15th November. GANGADHAR (1968) reported that the flea beetle reached its peak activity just before after pruning of vines. In the present investigations also, peak population of adult was observed before pruning (23rd sept.) But the population was nil after pruning (1st October) probably due to the non-availability of foliage consequent of pruning of all the vines at one time and the intensive plant protection measures taken immediately after pruning by the grape growers. The reappearance of the beetle on 8th October might be the population emerged from immature stages. The low population of the pest during November and complete disappearance during subsequent months could be attributed to the fall in the prevailing temperatures due to

TABLE 1. Seasonal occurrence of grapevine fleabeetle, *S. strigicollis*.

Period of observation		Population of								
		Grubs				Pupae				Adults
Month	Date	0—5 cm	6—10 cm	11—15 cm	16—20 cm	0—5 cm	6—10 cm	11—15 cm	16—20 cm	
June	1	0	0	0	0	0	0	0	0	0
	8	5	0	0	0	0	0	0	0	0
	15	0	0	0	0	0	0	0	0	0
	23	4	2	0	0	2	1	0	0	0
July	1	20	6	0	0	3	2	0	0	0
	8	20	10	3	0	5	3	0	0	0
	15	17	13	7	8	5	4	2	0	0
	23	47	6	5	4	25	3	3	5	7
August	1	15	4	4	1	15	3	1	0	10
	8	5	2	1	0	10	5	0	0	13
	15	6	2	0	0	2	1	0	0	15
	23	5	2	0	0	2	2	0	0	20
September	1	3	0	0	0	3	0	0	0	25
	8	43	9	2	0	25	4	1	0	30
	15	10	3	0	0	15	5	0	0	31
	23	8	2	0	0	10	5	0	0	35
October	1	3	0	0	0	2	0	0	0	0
	8	0	0	0	0	0	0	0	0	20
	15	0	0	0	0	0	0	0	0	10
	23	0	0	0	0	0	0	0	0	7
November	1	0	0	0	0	0	0	0	0	4
	8	0	0	0	0	0	0	0	0	2
Nov. 15th to April 23rd		0	0	0	0	0	0	0	0	0

the onset of winter and is in agreement with the findings of PANDE (1968) and KHANDUJA & JEHAN (1971).

It is also evident from the data that the population of grubs and pupae was more at a depth of 0-5 cm followed by 6-10 cm and were lesser in number at 11-15 and 16-20 cm. This shows that most of the population of grubs and pupae occur in top layers of the soil upto 10 cm depth. This interesting information helps in achieving better control of the pest by the application of a dust or granular formulation of an effective insecticide confining up to 10 cm depth of the soil during July.

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BRIEF COMMUNICATION

OBSERVATIONS ON THE INFESTATION OF AQUATIC INSECTS BY THE RED WATER MITES (ACARINA : HYDRACHNIDAE)

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The aquatic insects that were collected during the period 1979—1982, from different places in Tamil Nadu were found to be infested with the red watermites *Hydrachna* sp. This paper records the infestation on *Anisops bouveri* Kirkaldy, *Anisops breddeni* Kirkaldy, *Ranatra filiformis*, *Ranatra elongata* and *Belostoma indica*. The intensity of infestation varied from 1 to 30. All the infestations were recorded only on the adults.

(*Key words:* infestation of aquatic insects, red watermites)

Although larval mites commonly infest aquatic insects and insects with aquatic stage, published records of this phenomenon are relatively few. The present paper records the infestation of *Ranatra filiformis*, *Ranatra elongata*, *Anisops bouveri*, *Anisops breddeni* and *Belostoma indica* by *Hydrachna* sp. during 1979—1982 from several places in Tamil Nadu. The distribution of the mites on the host and the effect of ectoparasitism are discussed.

Previous literature on the infestation of aquatic insects by the water mites are those of DUGES (1834), TORRE-BUENO (1917) on *Gerris remiges*, LUNDBLAD (1927), IMAMURA (1952), SPARING (1959), WEEREKOON (1956), FERNANDO (1958) and JONES (1967). COBRET (1963) noted that mite infestation could be used for age grading in mosquitoes. FERNANDO & GALBRAITH (1970) have recorded a heavy infestation of *Limnochares* sp. on *Gerris comatus*. HARRIS (1970), and HARRIS & HARRISON (1974) have recorded the infestation in Corixidae.

The larval mites were mainly attached in the region of the eyes, hind legs, keel and in the pleuron region of the body between the middle and hind legs. Our observations show that depending upon the place of attachment of the nymphs and the number of mites per insect the behaviour of the insects differed. If more than one mite is attached to the body of *Anisops bouveri* it is very sluggish and if the attachment is in the region of the eye than it is unable to locate the prey even when it is within its reach. Infested *Anisops* behaved like the normal ones if the ectoparasites detach themselves or when voluntarily detached. We have collected fifteen specimens in which four infested *Anisops bouveri* from a temporary pond near Ponmali railway station at Trichy while the remaining from the Red hills reservoir at Madras. The number of ectoparasites

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ranged from 1 to a maximum of 3 per individual.

There is a high preference for the *Hydrachna* sp. to *Ranatra filiformis* and *Ranatra elongata* though Gerrids, *Sphero-dema*, and other aquatic insects were found in the same habitat The number of ectoparasites encountered in *Ranatra* species ranged between 6 to 15 per individual. In *Ranatra* the mites seem to prefer the pleuron region between the middle and hind legs although some were attachd to the dorsal and ventral side of the body.

In the case of *Belostoma indica* the mites were attached on the dorsal surface of the body in the scutellar region. Five specimens were observed in which the mites ranged between 25 to 30 per individual. They were collected using the light trap in Tiruvanmiyur in Madras.

From the above observations it appears that there could be host site preference in different species by *Hydrachna* sp. but observations on more hosts are required to confirm this. According to WEEREKOON (1956) the watermites are dispersed from one body of fresh water to another by insects since water mites are found commonly on aquatic insects which are known to fly from one body of fresh water to another hence serves a carrier for the dispersal of mites.

Acknowledgement: We would like to thank the authorities of Loyola College, Madras, the Principal Rev. Fr. F. J. KURIAKOSE in particular for extending all facilities to carry out this work and also to my colleague Mr. VASUDEVAN who assisted us in the collection of *Belostoma indica.*

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BRIEF COMMUNICATION

NEW RECORDS OF TWO PARASITES OF BRINJAL SHOOT AND FRUIT BORER, *LEUCINODES ORBONALIS* GUEN.

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(Received 9 August 1983)

Phanerotoma sp. (nr. *hindecasisella* Cameron) and *Campyloneura* sp. are recorded for the first time as larval parasites of *Leucinodes orbonalis* Guen. infesting egg plant (*Solanum melongena* Linn.).

(*Key words: Phanerotoma* sp., *Campyloneura* sp., larval parasite, *Leucinodes orbonalis*)

Leucinodes orbonalis Guen. has been reported as a serious pest of egg plant throughout India (LALL, 1964) and potato in Mysore (RAMACHANDRAN NAIR, 1967). Besides, it has also been recorded on *Solanum xanthocarpum* Schard & Wendl.; *S. indicum* Linn. (MENON, 1962); *S. nigrum* Linn. and number of other hosts (RAMACHANDRAN NAIR, 1967).

Only a few parasites have been recorded on it from different parts of the world. THOMPSON (1946) listed two Ichneumonids, *Cremastus flavoorbitalis* Cam. and *Pristomerus testacerus* Morl. from India and one Sarcophagid, *Amobia* sp. from Malaya as parasites of *Leucinodes orbonalis* Guen. He also listed a Tachinid parasite, *Sturmia parachrysops* Bezzi from India parasitizing *Leucinodes* sp. VENKATRAMAN (1948) was successful in rearing *Bracon greeni* Ashmead on the larvae of *L. orbonalis* Guen. in the laboratory. HERTING (1975) listed *Ephialtes dimorphus* Cushman and *Trichogramma minutum* Riley as parasites of *Leucinodes elegantalis* G.

Contribution No 295/83 of Indian Institute of Horticultural Research, 255, Upper Palace orchards, Bangalore, 560 080.

During a study to find out natural mortality factors in *Leucinodes orbonalis* Guen. infesting brinjal around Bangalore, two parasites, *Phanerotoma* sp. (nr *hindecasisella* Cameron) (Hymenoptera : Braconidae) and *Campyloneura* sp. (Hymenoptera : Braconidae) were observed parasitizing the larvae in the month of July, 1982. Cumulative parasitization by both the parasites was of low level ranging from 1 to 2 per cent. Number of larvae parasitized by *Campyloneura* sp. were more than those parasitized by *Phanerotoma* sp.

Earlier, *Phanerotoma hindecasisella* Cameron has been reported from India as a parasite of *Dichomeris evidantis* Meyr., *Earias insulana* Boisd, *Hendecasis duplifasciella* Hamps, *Nephopteryx rhodobasalis* Hamps, *Pammene theristis* Meyr., *Pyrausta machaeralis* Walk, *Sylepta derogata* F. (THOMPSON, 1953) and *Cydia ptychora* Meyr. (KUMAR *et al.*, 1980). It has also been recorded from Sri Lanka parasitizing *Maruca testulalis* (Geyer) larvae (FELLOWES & AMARASENA, 1977). *Phanerotoma* sp. has been reported as larval parasite of *Phophantis smargdina* Butler (DERRON, 1977) and *Maruca*

testulalis (Geyer) (USUA & SINGH 1978). THOMPSON (1953) listed *Campyloneurus ceylonicus* Cam. as parasite of *Alcides bubo* F. and *C. indicus* Ayyar on *Laccifer lacca* Kerr. from India. *Campyloneurus mutator* F. was reported parasitizing *Chilo auricilus* (Dudg.) infesting sugarcane in Assam (RAO & NAGARKATTI. 1971).

Thus, it is evident that both *Phanerotoma* sp. (nr. *hindecasisella* Cameron) and *Campyloneura* sp. are new records as parasites of *Leucinodes orbonalis* Guen.

Acknowledgements: The authors are thankful to the Director, Commonwealth Institute of Entomology, London for identification of both the parasites.

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BRIEF COMMUNICATION

BREEDING PLACES AND SEASONAL ABUNDANCE OF BANCROFTIAN FILARIASIS VECTOR *CULEX QUINQUEFASCIATUS* (DIPTERA : CULICIDAE) IN GURGAON

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(*Received* 22 *May* 1983)

From January 1980 to February 1981 the adult and immature populations of *Culex quinquefasciatus* were monitored in six typical crowded urban areas of Gurgaon. The highest frequency of breeding (28%) of *Culex quinquefasciatus* was observed in pits. The drains were infested to a greater extent having 2.15 density/dip in the month of October 1980. The highest man-hour density (34.16) was recorded in the month of April, 1980 for adult *Culex quinquefasciatus*. The container index for *Culex quinquefasciatus* rose from a dry season of 0.4 to a wet season of 2.3. At the same time, the premise index increased from 3.2 to 11.6, and the Breteau index from 0.2 to 16.2.

(*Key words:* breeding place, seasonal abundance, *Culex quinquefasciatus*).

The common house mosquito, *Culex quinquefasciatus* is the vector of human filariasis due to *Wuchereria bancrofti* in India. PAL *et al.* (1960) studied some aspects on bionomics of the vectors in Kerala. Epidemiological studies on Barcorftian filariasis in Andhra Pradesh was done by RAO *et al.* (1981). DHAR *et al.* (1968) observed that transmission of Bancroftian infection was directly proportional to biting density of the vector. The studies in Manglore (Karnatka) and Barabanki (Uttar Predesh) showed no correlation between vector density and vector infection and infectivity rates (SUBRAMANIUM & TAMPI 1958: NANDA *et al*, 1962). This study was carried out in Gurgaon urban area to elucidate the breeding places and seasonal abundance of *Culex quinquefasciatus* from Jan. 1980 to Feb. 1981.

The Gurgaon city with a population 1,06,316 and total area 10 sq. km. is situated 35 km. from Delhi. The average annual rainfall is 99 8 mm., and there are two main seasons, wet and dry. There are three main types of housing: (1) large double storey buildings in commercial and residential areas; (2) bungalows, each located within its own compound: (3) a new type of single-storey residential houses under Haryana Urban Development Authority in the more recent extensions of the city. The population density is highest in the third type housing and lowest in second type. Abundant and continious piped water is supplied by city authorities. Pits are the most important breeding sites for *Culex quinquefasciatus*. Daily introductions of garbage, human waste and domestic wash water make them unstable. High larval densities occur throughout the year, except for June to August. Drains and house tanks are also good breeding sources for *Culex quinquefasciatus* in the dry season. Singel larval collection according to the technique developed by SHEPPARD *et al.* (1969) were made weekly in all the

Table 1. Mean *Culex quinquefasciatus* larval indices for seven dry months (Nov.—March 1980 and January—Feburary 1981) and wet months (April—October 1981).

Season[a]	Wet containers %	Container index	Premise index	Breteau[b] index
Dry	0.8	0.4	3.2	0.2
Wet	15 2	2.3	11.6	16.20

a. Total rainfail of 17.8 mm for seven dry months compared with 82mm for seven wet months.
b. No. of positive containers per 100 houses.

Table 2. Monthly mean number per man-hour of *Culex quinquefasciatus* from Janurry, 1980 to Feburary, 1981.

	Months (1980)												Month (1981)	
Findings	Jan.	Feb.	Mar	Apr	May	June	July	Aug	Sep	Oct	Nov	Dec	Jan	Feb
No. of fixed capture station	110	120	100	120	100	115	115	110	105	90	100	125	105	100
No. of random capture station	66	72	60	72	60	69	69	66	63	54	60	75	66	72
Total man-hour-spent	44	48	40	48	40	46	46	44	42	36	40	50	42	40
Density per-man-hour	9.4	7.3	14.5	30.6	18.4	17.2	22.8	18.8	13.5	20.3	17.3	2.7	12.4	14.3

localities of the city. Houses and premises were examined. The survey consisted essentially in searching for water containers, counting them and classifying them according to their type and location (outdoors or indoors) and examining the containers for their presence of *Culex quinquefasciatus*. The collections were made by insect collector under the supervision of a health inspector. Outdoor containers consisted of mainly discarded artifacts and automobile parts whenever get filled with rain water. Indoor containers are kept manually filled with water for domestic purposes. Drums, mud pots, discarded motor vehicle bodies and parts were the important containers in the survey. Adult mosquito collections were carried out between 6 a m to 8.30 a m with aspirator tube and flash light from different capturing stations (human dwellings, cattle sheds and mixed sheds) from the periphral and central zone of the town.

The results obtained by single-larval-per-container method of larval survey (Table 1) show that the container index for *Culex quinquefasciatus* rose from a dry season average of 0.4 to a wet season average of 2.3. At the same

time, the premise index increased from 3.2 to 11.6, while the Breteau index rose from 0.2 to 16.2. The pooled results of entire period (Jan. 1980 Feb. 1981) show that pits were the most frequent sites of breeding (28%). Drains were also next highest breeding places having 2.15 density per dip in Oct. 1980. The average monthly adult density (Table 2) are related to rainfall during the surveys. The frequency of infestation is lowest in cool, dry season and highest in the season of long rains.

Since there was no survey of every breeding place as well as container in any locality, the results cannot be expected to give an accurate indication of the proportion of different types of water collections. water holding containers and actual or potential water holding. Taking the year Jan. 1980 Feb. 1981 as a whole, it was found that pits were the most frequently infested breeding places followed by drains and ponds. For practical purposes, the single larval survey employed has highlighted the breeding potential of *Culex quinquefasciatus* in different type of container and thus has provided valuable information for controlling this species. From the ecological point of view. the results of survey has shown that pits are the most favourable site for *Culex quinquefasciatus* larvae.

Acknowledgements: The authors are greatly indebted to Dr. K. L. SIKKA, Joint Director (Malaria) and Sh. VINOD KHOSLA, Assitt. Director (Entomology) for encouragement. Thanks are also due to Dr. S. K. SHARMA, Director, Health Services (Haryana), Chandigarh for facilities.

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Entomon, 1984, *Vol.* 9, *No.* 1, *pp.* 69 *to* 70

BRIEF COMMUNICATION

LARVAL FEEDING BEHAVIOUR OF TOP BORER, *SCIRPOPHAGA NIVELLA* F. IN RELATION TO GROWTH OF SUGARCANE PLANT

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(Received 2 February 1983)

Feeding behaviour of the larva of the top borer, *Scirpophaga nivella* F. within the spindle in relation to growth of sugarcane plant is presented.

(Key words: feeding behaviour, *Scirpaphaga nivella larva)*

Biology of the top borer of sugarcane, *Scirpophaga nivella* F. an important pest in south-east Asia, has been well documented in India (BAGAL & PATEL, 1953; KALRA & SIDHU, 1965). Information is available on feeding site and subsequent tunneling by the invading larvae. However, feeding behaviour of larva within a spindle is as yet not understood clearly. Investigations in this respect are reported here.

Two hundred, six month old plants of sugarcane cultivar *Co 1148*, exhibiting while streak on freshly unfurled leaves of the spindle, a characteristic symptom of new attack, were tagged during August, the period of peak emergence of moths at the Institute farm.

Of these, five plants were picked at random every 24 hours for 25 days. These were split longitudinally. The site of feeding, stage and number of larvae in the spindle and their position in relation to apical meristem up to preparation of exit hole and pupation, were noted.

Larvae boring through the midrib of first or second opened leaf made their way into the centre of the spindle in 24 to 48 hours. First moult occurred during this period. In majority of cases only one larva and occasionally two larvae were found in a spindle.

However, only one larva survived beyond 2nd instar stage. Larvae in third to fifth instar stage fed on newly formed immature leaves in the centre of spindle.

These appeared to be avoiding outer whorl of leaves in all cases. In no case any change in the feeding site was noticed. Just before pupation larvae were noted to cut across the apical meristem, tunnel down to lower internodes prepare an exit hole and pupate. A few of the larvae, up to third instar, were found dead in the spindle, in some cases.

The observations showed that following entry into the heart of spindle, the larvae feed *in situ* only on immature inner leaves prior to pupation. Inside a spindle larvae of 2nd to 5th instars were found from 1.5 to 15 cm away from the apical meristem. Many times larvae were found to have reached close to apical meristem but tended to regulate their feeding so as not to damage the

latter. It was apparently to ensure continued availability of immature leaves, its main diet. Occasional nibbling of immature leaves in the outer periphery appears to import the "shoot holes" symptom on unfurled leaves. This observation is at variance with reports of BAGAL & PATEL. 1953; HUQUE & AGARWALA, 1955 and KALRA & SIDHU, 1965 who regarded the "shoot holes" as sites of passage of larva from midrib in to the spindle.

Examination of the arrangement of the unfurled leaves and the size of larvae when it gains its first entrance into the spindle does not appear to support earlier thinking. Dead larvae in spindle were of 2nd or 3rd instar only. In all such cases there was a significant gap between the tip of young immature leaf and the dead larva. The death of the larva could either be due to inability of larva to reach the feeding site or cessation in development of rudimentary leaves that it feeds on.

Tagged plants having retarted rate of growth, in the period when larvae fed on rudimentary spindle-leaves, apical meristem being undamaged, continued to grow such an attack is infructuous. KALRA & CHAUDHARY (1964) thought that infructuous attack were due to vigorous cane growth which out-paced young larvae in reaching growing point. The present observations show that since the larva gains its entry into the spindle very early and establishes there itself and the cane grows below the apical meristem, the relative position of larva and apical meristem remains unchanged irrespective of growth of the cane. It is not clearly understood as to why earlier instars feed only on rudimentary leaves and carefully bypass the growing point. Precisely the reverse is true for the last instars which cut across the apical meristem feed on tissues of stalk and then pupates.

The observations presented here do not support popular notion of relating spindle length with degree of resistance of cane plant against top borer attack. (KHANNA & RAMANATHAN, 1946; ADLAKHA, 1964).

Larvae cut apical meristem juit getting ready to pupate. This arrests further growth of the plant. It would appear, though not experimentally proved, that pupation inside the spindle without damaging the apical meristem would have been disastrous to the life of top borer. Uninterrupted growth of the attacked plant would have checked the moth emergence by plugging the exit hole.

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Entomon, 1984, *Vol.* 9, *No.* 1, *pp.* 71 *to* 72

BRIEF COMMUNICATION

NEW RECORDS OF PARASITES OF *HYMENIA RECURVALIS* (LEPIDOPTERA : PYRALIDAE) ON *AMARANTHUS*

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(Received 17 October 1983)

Hymenia recurvalis infesting *Amaranthus* sp. was found to be parasitised by *Apanteles hemara* (Hymenoptera : Braconidae), *Campoletis chlorideae* Uchida (Hymenoptera: Ichneumonidae), *Phanerotoma hendecasisella* Cameron (Hymenoptera: Braconidae) and *Apanteles opacus* Ashmead (Hymenoptera : Braconidae). All these parasites are new records for the pest and are being reported for the first time from India

(Key words: Amaranthus leaf webber, parasites)

Hymenia recurvalis (Fabricius) is a major pest of all varieties of *Amaranthus* particularly the cultivated species, *A. gangeticus* and *A. mangostanus* which are attacked the most. The caterpillar webs together the leaves and feeds within, skeletonising the leaves completely (BHATTACHERJEE & MENON, 1964).

H. recurvalis has been reported to be parasitised by a large number of parasites. NARAYANAN *et al.* (1957) recorded three primary parasites namely an *Apanteles* sp. and an unidentified Ichneumonid and a Braconid. Although the degree of parasitism by *Apanteles* was recorded to be 62 per cent, the pest was not controlled owing to the presence of eight different species of hyperparasites attacking the cocoons of this primary parasite. *Apanteles delhiensis* was described by MUESBECK & SUBBA RAO (1958) from specimens reared from *H. recurvalis.* Subsequently, BHATTACHERJEE & MENON (1960) recorded a natural parasitism of 11.43 per cent by *A. delhiensis.* PARSHAD *et al.* (1968) reported 16 per cent parasitism by *Cardiochiles hymeniae.* The following 4 parasites were reared from this pest by CHAUDHARY & KAPIL (1975): *Chelonus venatilis* Wlkn., *Apanteles* sp. near *antilla* Nixon, *Prosopodopsis* sp., and *Cardiochiles fulvus* Cam.

In June-August 1982, a large number of larvae of *H. recurvalis* were collected from the field in and around Bangalore and reared in the laboratory for studying the extent of parasitism occurring in nature. During the course of this study, *Apanteles hemara* Nixon (Braconidae) was found to be the most dominant parasite occounting for 11.0 per cent mortality of the pest. *Campoletis chlorideae* Uchida (Ichneumonidae) caused 4.0 per cent mortality. *Phanerotoma hendecasisella* Cameron (Braconidae) and *Apanteles opacus* Ashmead (Braconidae) accounted for 2.0 and 1.0 per cent parasitism respectively. All four parasites listed above are new records for *H. recurvalis* and are being reported for the first time from India.

The three hyperparasites reared from *Apanteles* cocoons were *Aphanogmus fijiensis* (Ferriere) (Ceraphronidae), *Perilampus microgastri* Ferriere (Perilampidae)

and *Diaglyptidea* sp. (Ichneumonidae). Of these, *A. fijiensis* accounted for the maximum mortality of *Apanteles* spp. NARAYANAN *et al.* (1957) reported 30 per cent parasitism by an unidentified elasmid which was the highest among the eight hyperparasites he reported attacktng *Apanteles* sp.

Acknowledgement: The authors are grateful to Dr. G. NIXON, Commonwealth Institute of Entomology for identifying the Braconid parasites and to Mr. I. D. GAULD for determining the Ichneumonidae.

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BRIEF COMMUNICATION

NEW REPORT OF PARASITES ON MANGO FLEAWEEVIL, *RHYNCHAENUS MANGIFERAE* (COLEOPTERA : CURCULIONIDAE)

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(*Received 17 October 1983*)

The paper records four new parasites viz. *Cirrospilus quadristriatus* S. R. and R., *Teleopterus* sp. (Hymenoptera: Eulophidae), *Eudefus* sp. (Hymenoptera: Eulophidae) and *Sphegigaster* sp. (Pteromalidae) on the mango fleaweevil *Rhynchaenus mangiferae*, all being reported for the first time from India.

(*Key words:* mango fleaweevil, Parasites)

The Mango fleaweevil, *Rhynchaenus mangiferae* Marshall is normally a minor pest of mango in South India. Until recently, its economic status has been considered insignificant. But now it is beginning to cause economic damage to mango crops. Both adults and grubs damage the leaves. The adult feeds gregariously on young foliage by eating away small oval holes from the under-side of leaf lamina leaving the upper thin membraneous epidermis. The membraneous epidermis gradually dries, turns brown and shrivels. In case of severe attack, the leaves become badly spotted and skeletonised.

In May 1979, a severe infestation of young foliage by this insect was observed on mango trees grown in and around Bangalore. A survey for natural enemies of *Rhynchaenus mangiferae* was carried out to determine extent of natural biological control occurring in the field.

Infested leaves were collected and held in tubes until the emergence of parasites or the pest adult. Four parasites were reared from this host of which *Cirrospilus quadristriatus* S. R. and R. was the most dominant. In the present investigation, the extent of parasitism by this natural enemy during May-June was on an average 35.8 per cent. VISHAKANTAIAH (1973) recorded *Cirrospilus* sp. parasiting this pest to the extent of 12—86 per cent during the major flushing season.

The other parasites recorded were *Teleopterus* sp. (Eulophidae), *Euderus* sp. (Eulophidae) and *Sphegigaster* sp. (Pteromalidae). The combined parasitism by the three above mentioned parasites was 8.0 per cent.

All four parasites are new records for *Rhynchaenus mangiferae* and is being reported for the first time from India.

Acknowledgement: The authors are grateful to Dr. Z. BOUCEK, Commonwealth Institute of Entomology, for identifying the Eulophid parasites and to Dr. B. R. SUBBA RAO, for determining the Pteromalidae.

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Entomon, 1984, *Vol.* 9, *No.* 1, *pp.* 75

BRIEF COMMUNICATION

PSEUDALSOMYIA SP. A NEW PARASITE OF *LEMA LAECORDAEIREI* B.

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(Received 26 May 1983)

A tachinid, *Pseudalsomyia* sp., is newly recorded as an endoparasite of *Lema laecordaeirei* Baly., a pest of edible yams.

(*words*: tachinid parasite, *Pseudalsomyia* sp., *Lema laecordaeirei*, edible yams.)

Lema laecordaeirei Baly (Chrysomelidae: Coleoptera) is a pest of edible yams, *Dioscorea alata* and *D. rotundata*. Both grubs and adult beetles feed on the leaves (VISALAKSHI & NAIR, 1978). Recently the authors observed a tachinid fly parasitizing grubs of the pest. This was identified as *Pseudalsomyia* sp. (Tachinidae: Diptera).

The pest was prevalent during August-December in the field at CTCRI farm, and the activity of the parasite was observed during October—November. The field parasitisation ranged from 7-9 per cent. In the laboratory the adult fly oviposited on young grubs (usually second instars). A single female fly could parasitize 8—13 grubs in its life time. The parasite grew along with the host and completed the egg and larval period within 5—6 days. The parasitized grub pupated inside a white puparium and the parasite (maggot) pupated within the host pupa. More than one parasite developed from a single host and flies emerged after 6—7 days. The total life cycle of the parasite ranged from 11—13 days. Adult flies were found to live upto 15 days.

There are very few records of tachinids parasitizing chrysomelid larvae (HARRIS, Personal communication). This endoparasite, *Pseudalsomyia* sp. is a new addition to Indian tachinids parasitizing chrysomelid larvae.

Acknowledgement: Authors are thankful to the Director CTCRI, Trivandrum for the facilities during the studies. They extend there gratitude to the Director of C I E and Dr. K. M. HARRIS, taxonomist, British Museum, London for identifying the insect.

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Publication No. 377, Central Tuber Crops Research Institute, Trivandrum.

Entomon, 1984, *Vol.* 9, *No.* 1, *pp.* 77 *to* 78

BRIEF COMMUNICATION

RECORD OF TRUE PARASITISM IN *PERIBAEA ORBATA* (WIED.) (DIPTERA : TACHINIDAE)

K. P. JAYANTH & SUDHA NAGARKATTI

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One to twelve maggots of *Peribaea orbata* emerged from a single full grown larva of the host *Spodoptera litura*. Some host larvae survive after emergence of the parasite. If the host larva is nearly full grown the developing maggots may not be able to destroy the vital organs, allowing the host to survive and reproduce.

(Key words: true parasitism, *Peribaea orbata).*

Parasitism is a type of consortism in which the parasite progressively obtains benefits for itself at the continuing expense of the host (WOODBURY, 1954) although it is not usually destroyed. Parasitic insects differ from true parasites in many respects and have theresore often been referred to as parasitoids to distinguish them from true parasites. The term parasitoid is used for arthropods where the egg and larval stages are parasitic, but the host is eventually killed (VINSON, 1975). Parasitoids include a vast number of species of the so-called parasitic Hymenoptera, the Strepsiptera, Diptera, Coleoptera and Lepidoptera.

Insects are known to escape parasitism by encapsulating the egg or larval stages of the parasitoids with phagocytic blood cells which arrest embryonic development or prevent the escape of young parasitoid larvae. Thus the inhibition of the development of the parasite embryos of *Mesoleius tenthredinidis* Morley in the larch sawfly *(Pristiphora erichsonii* Hartig) seemed to be related to the deposition of phagocytic capsules around them (WIGGLESWORTH, 1959). Here the authors record an interesting phenomenon which allowed the host to survive even after parasite development.

Peribaea orbata (Wied.) is an important tachinid larval parasite of *Spodoptera litura* (Fb.) (Lepidoptera : Noctuidae) in India. One to twelve maggots of the former have been observed to emerge from a single full grown larva of the host. In the course of laboratory multiplication of this dipteran it was observed that some of the host larvae svrvive after emergence of the parasite. Two hosts which were parasitized by the tachinid survived even after one and four parasites had emerged and pupated normally, producing healthy female moths. These were separately related into cages with normal males. The female from which one parasite maggot had emerged, laid about 400 fertile eggs, although *S. litura* are capable of laying upto 2000 eggs (NAIR, 1975).

Contribution No. 128/83 of the Indian Institute of Horticultural Research, Bangalore - 560 080.

The other female from which four parasites had emerged, laid only a few unfertilized eggs due perhaps to unsuccessful mating. However, on dissection, the ovaries of this female were found to be full of eggs.

From this study it appears that if the host larva is nearly full grown occasionally the developing maggots are unable to destroy the vital organs, thus allowing the host to survive and reproduce, a behaviour characteristic of typical parasites. This, however, does not seem to be the case when younger instars of the host are parasitized when the hosts succumb to parasitism. Similar instances of deviation from the parasitoid habit have been recorded in entomophagous insects that attack the adult stages of their hosts. Braconidae (Hymenoptera) of the tribe Euphorini (ASKEW, 1971) and the tachinid *Thirixion* sp. (CLAUSEN, 1940) occasionally allow the hosts to survive and reproduce. This phenomenon, like encapsulation is of particular interest from the stand point of evolution and biological control.

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ENTOMON

(Form IV, Rule 8 of the Registration of Newspapers (Central) Rules, 1956)

1.	Place of publication:	Trivandrum
2.	Periodicity of publication:	Quarterly
3.	Printer's name, nationality and address:	V. K. Kesava Prabhu, Indian, Department of Zoology, University of Kerala, Kariavattom, Trivandrum 695 581.
4.	Publisher's name, nationality and address	—Do—
5.	Editor's name, nationality and address:	—Do—
6.	Name and address of individual who owns the newspaper:	Association for Advancement of Entomology, Department of Zoology, University of Kerala, Kariavattom, Trivandrum 695 581.

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Printed by V. K. K. Prabhu at GEO Printers, Plamood. Trivandrum 695 004
for the Association for Advancement of Entomology.